Nova Scotia
**Department of
Mines and Energy**

Information Series
No. 6

Seventh Annual Open House and Review of Activities

November 30 and December 1, 1983

PROGRAM AND SUMMARIES

Honourable Joel R. Matheson, Q.C., Minister
John J. Laffin, P. Eng., Deputy Minister
HALIFAX, NOVA SCOTIA
1983

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FOREWORD

It is a pleasure for me to be able to use the occasion of the Department's Seventh Annual Open House and Review of Activities as my formal introduction to the mining and exploration community.

My understanding is that this Open House format has evolved over the past seven years from a relatively informal presentation of the geological work of our Mineral Resources Division into the present more comprehensive review of activities of both the Mines and Minerals and Energy Branches, therefore encompassing mineral, coal, and offshore hydrocarbon studies.

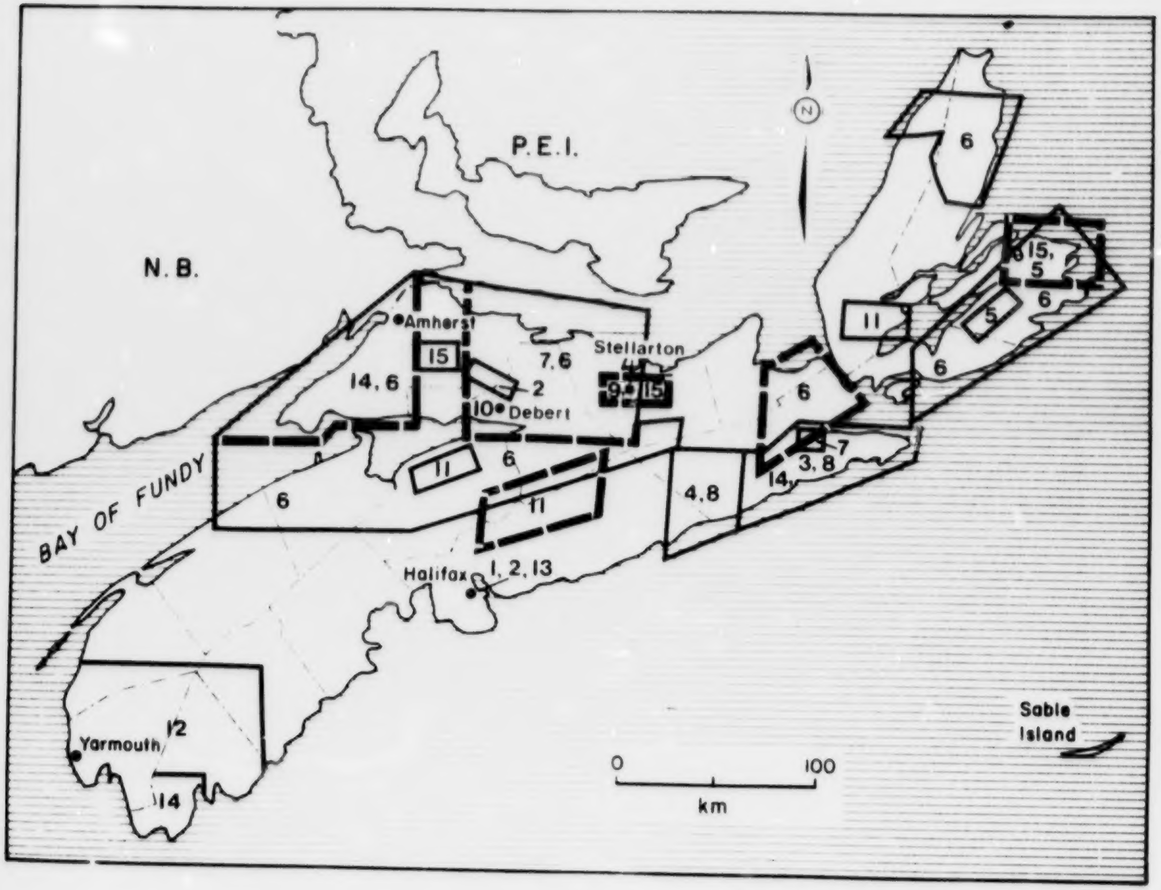
The major thrust of this particular publication continues to be onshore exploration, and it is encouraging that this year marked a significant improvement in private sector expenditures in this area. The inclusion of a special symposium on a two-year research program to provide a better understanding of the gold mining potential of Nova Scotia should be of significant assistance in fostering increased exploration for this metal.

The documentation of this and other programs supported by our current Canada/Nova Scotia Cooperative Mineral Agreement represent the nucleus of this Review and illustrates some of this Department's important and varied responsibilities. I am particularly gratified to see the continuation of the Department's long-standing cooperative research efforts with the Federal Department of Energy, Mines and Resources, and our local universities.

The reactivation of production from this Province's metal sector has been recently confirmed by Rio Algom's announcement of a major new tin mine development in Yarmouth County. Production in our traditional industrial and construction materials sectors has been maintained throughout this recessionary cycle. These factors, coupled with this Government's support of the coal industry and our optimism for major offshore resource development, is an extremely exciting platform for the initiation of my tenure in this portfolio. This Department recognizes the irreplaceable role of the private sector in the full utilization of Nova Scotia's mineral resources. I trust that, through programs like this, we can continue to play a constructive role in your pursuit of viable development opportunities.

Joel R. Matheson

Joel R. Matheson, Q.C.
Minister of Mines and Energy



1983 Programs

1. Education and Public Awareness
2. Mineral Deposits*
3. Meguma Gold Project*
4. Meguma Gold Project (GSC)*
5. Sydney Basin Study*
6. Applied Geochemical Surveys*
7. Surficial Mapping and Till Geochemistry (GSC)*
8. Gradiometer Survey (GSC)*
9. Regional Office; Core Library and Storage (GSC)*
10. Core Storage*
11. Cretaceous Project*
12. Aggregate Resources
13. Mineral Inventory (GSC)*
14. Peat Exploration
15. Coal exploration

* Indicates Programs funded under the Canada - Nova Scotia Cooperative Mineral Program, 1981-84.

(GSC) Indicates whole or partial funding by the Geological Survey of Canada

Nova Scotia
Department of Mines and Energy

Honourable Joel Matheson Q.C.
Minister

John J. Laffin, P Eng
Deputy Minister

INFORMATION

SEVENTH ANNUAL OPEN HOUSE AND REVIEW OF ACTIVITIES

The Lord Nelson Hotel, Halifax

Program

WEDNESDAY, NOVEMBER 30, 1983

SPECIAL SYMPOSIUM: MEGUMA GOLD PROJECT

12:55	INTRODUCTION Peter Giles
13:00	GEOLOGY OF THE EASTERN MEGUMA TERRANE Duncan Keppie
13:15	SEDIMENTOLOGY AND STRATIGRAPHY IN THE GOLDENVILLE FORMATION John Waldron
13:30	GRADIOMETER RESULTS IN THE GOLDENVILLE FORMATION Lynden Jensen
13:45	AIRBOURNE GRADIOMETER SURVEYS IN THE MEGUMA TERRANE Peter Hood
14:00	STRUCTURE OF VEINS IN THE EASTERN MEGUMA TERRANE Brian O'Brien
14:15	STRUCTURE AND VEIN MORPHOLOGY OF THE MEGUMA GROUP IN THE MOSER RIVER AREA Jack Henderson
14:30	METAMORPHISM IN THE EASTERN MEGUMA TERRANE Gunter Muecke
14:45	COFFEE BREAK
15:00	PLUTONISM IN THE COUNTRY HARBOUR AREA George O'Reilly
15:15	HALFWAY COVE AND QUEENSPORT GRANITOID PLUTONS Linda Ham
15:30	GRANITOID ROCKS OF THE SOUTHWESTERN MEGUMA TERRANE Dean Rogers
15:45	THE EASTVILLE STRATABOUND Pb DEPOSIT Marcas Zentilli
16:00	POLYGENETIC GOLD DEPOSITS IN THE EASTERN MEGUMA TERRANE Simon Haynes
16:15	COCHRANE HILL, CROWS NEST, AND FOREST HILL GOLD DEPOSITS Paul Smith
16:30	TILL STRATIGRAPHY AND GEOCHEMISTRY AT FOREST HILL Ian MacEachern
19:30	REGISTRATION
20:00 to 22:30	EVENING RECEPTION, CASH BAR OPENING OF DISPLAYS INFORMAL DISCUSSIONS

For registration or additional information, please contact:

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Halifax, Nova Scotia B3J 2X1
(902) 424-8598 or 6732

THURSDAY, DECEMBER 1, 1983

08:00-10:00	REGISTRATION
08:20	INTRODUCTION John J. Laffin, P. Eng. Deputy Minister WELCOMING ADDRESS, MINISTER OF MINES AND ENERGY Hon. Joel Matheson, Q. C.
08:40	PROGRAM INTRODUCTION Jack Garnett, P. Eng., Assistant Deputy Minister, Mines and Minerals
08:45	GEOLOGICAL SURVEYS DIVISION Peter Giles, Director
08:50	PROJECT GEOLOGY SECTION OVERVIEW Duncan Keppie, Section Manager
09:00	PLEISTOCENE GEOLOGY Ralph Stea
09:10	MINERAL DEPOSITS A. K. Chatterjee
09:20	GEOCHEMISTRY Peter Rogers
09:30	CARBONIFEROUS BASIN STUDIES Bob Boehner
09:40	CARBONIFEROUS STUDIES Margaret Best
09:50	TATAMAGOUCHE PROJECT Bob Ryan
10:00	MEGUMA GOLD PROJECT Duncan Keppie
10:10	ANTIGONISH HIGHLANDS Brendon Murphy
10:20	EDUCATION AND PUBLIC AWARENESS Howard Donohoe
10:30-10:55	BREAK
10:55	MINERAL DEVELOPMENT DIVISION Dan Murray, Director
11:05	EXPLORATION REVIEW John McMullin
11:20	INDUSTRIAL MINERALS AND AGGREGATE RESOURCES John Fowler
11:30	MINERAL INVENTORY Norman Lyttle
11:40	ENERGY BRANCH, ENERGY RESOURCES DIVISION Rick Hornby, Assistant Deputy Minister, Energy
11:50	COAL EXPLORATION Kevin Gillis
12:00	SPRINGHILL COAL PROJECT John Calder
12:10	PEAT EXPLORATION Sandy Anderson
12:20	OIL AND GAS EXPLORATION REVIEW Paul Harvey
12:35-14:00	LUNCH
13:30-16:00	DISPLAYS, INFORMAL DISCUSSIONS, CASH BAR

MINERAL EXPLORATION ACTIVITY IN NOVA SCOTIA TO OCTOBER 1983

J. M. McMullin

The level of mineral exploration during the past year has shown an improvement over the previous twelve month period, and a continuation of the trend is anticipated, but activity in general does not approach the levels of 1980-1981.

Gold, tin, tungsten, and barite have again been the prime targets for exploration. Exploration for the common base metals, (copper, lead, and zinc) has generated some activity, generally to a similar extent as the previous year.

Staking has been moderately active. Billiton Canada Ltd. and Seabright Resources Inc. are the largest claim holders. Chevron Canada Resources Ltd., Dome Exploration Ltd. and Amax of Canada Ltd. are no longer active in the Province, but several newcomers have started exploration programs or opened new offices. These include a group based in Vancouver (Outland Resources, Bear Pass Resources, and Acadian Gold Mines) and a group based in Toronto (Golden Shadow, Golden Caribou Explorations, Lake Mine Resources, and Isaacs Harbour Gold Resources). Both are looking primarily for gold. Also, Granges Exploration have been drilling the Smithfield base metal deposit during the past two years and have recently opened an office in the Halifax area.

A group headed by Doug Hunter and Lloyd Nelson are in the initial stages of a new program to re-evaluate the old Stirling mine.

GOLD EXPLORATION

Drilling was carried out this year in Guysborough County by Seabright Resources Ltd. at Forest Hill (Fig. 1), the Riddell group at Mile Lake, Acadia Mineral Ventures at Wine Harbour, Goldenville Exporations at Goldenville, and Outland Resources at Widow Point, Country Harbour. In Halifax County, Sullivan Mining Group drilled at Tangier and Acadian Gold Mines and M. E. X. Exploration Ltd. drilled Beaver Dam.

In Blockhouse, Lunenburg County, drilling was carried out by Golden Shadow and further drilling was done by Art Wright at Renfrew, Hants County. U. S. Borax drilled near Williamsdale, Cumberland County.

Other exploration consisted of gradiometer surveys (Seabright at Forest Hill, Goldenville at Goldenville), basal till/bedrock sampling (Riddell at Mile Lake, Outland at Widow Point), and rock trenching (Seabright at Forest Hill, Pan East/Consolidated Gold Fields at Mt. Uniacke, Hants County). Golden Caribou is rehabilitating and dewatering the Holman Shaft at Caribou, Halifax County, in preparation for underground sampling and drilling. Seabright Resources Ltd. continued studing the feasibility of gold recover from old tailings sites around the Province. Northumberland Mines is evalutating a leaching process for the Cochrane Hill Mine, Guysborough County. Outland Resources set up a mobile test mill at Widow Point and ran some bulk samples.

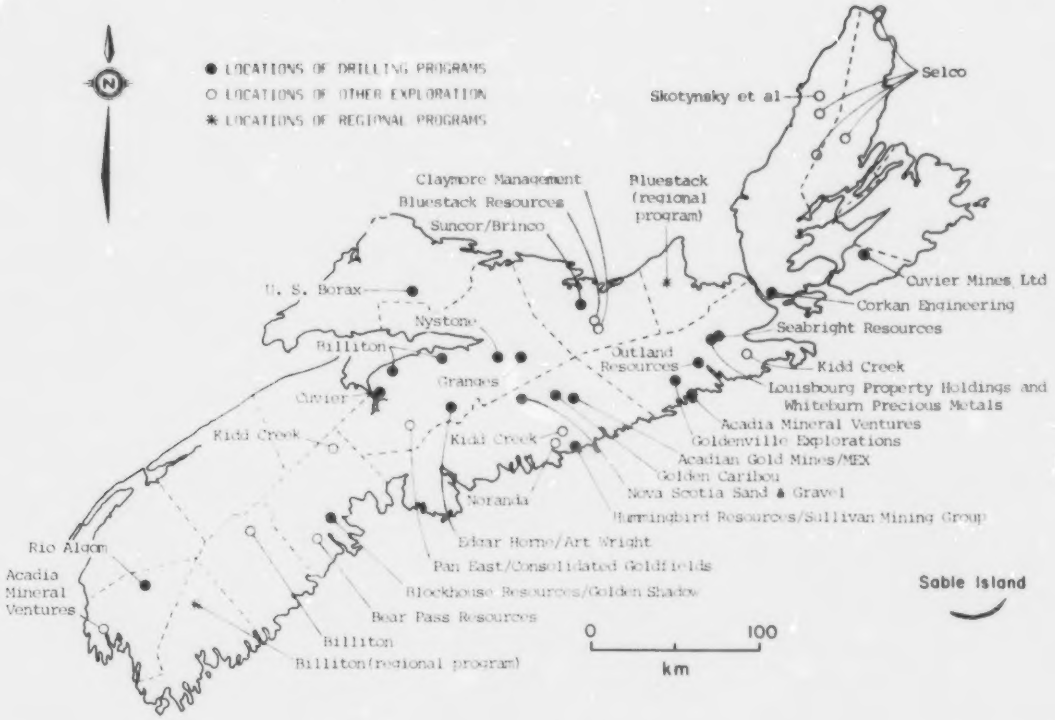


Figure 1. Mineral exploration activity in Nova Scotia to October 1983.

Geochemical and geophysical surveys, mapping, and prospecting were carried out in many parts of the Province, particularly in the old gold districts of the Meguma Group.

BASE METALS

The level of exploration activity has been similar to 1982. Selco Inc. has been active in the Cape Breton Highlands and the Bluestack Resources/Selco joint venture has continued geochemical exploration for base metals and barite in Pictou and Antigonish Counties. The old Stirling Mine area is being re-evaluated by a group organized by Doug Hunter and Lloyd Nelson. Selco is exploring the entire Stirling volcanic belt. Granges Exploration has carried out a third phase of deep drilling at the old Smithfield mine in Colchester County, held under option from Bruce Dunlop. Cuvier Mines drilled early in the year for base metals and barite at Burlington, Hants County.

Tin and tungsten were targets for exploration by Noranda Exploration in the Ship Harbour area and by Kidd Creek Mines Limited at Tangier Grand Lake; both sites are located on the Musquodoboit Batholith in Halifax County. Kidd Creek was also active in Manganese Mines, Lunenburg County and Sangster Lake, Guysborough County.

Rio Algom has been active all year with predevelopment work at its tin ore body at East Kemptville, Yarmouth County and further geochemical, geophysical exploration, and drilling in surrounding areas.

Billiton Canada Ltd., did extensive exploration for tin and tungsten on a large block of claims centered in Shelburne County, to the east of Rio's East Kemptville deposit. They conducted programs at Ship Harbour, Halifax County, and at Caledonia, Queens County and carried out diamond drilling for base metals in the Walton-Noel area, on the Horton/Windsor contact in Hants County.

BARITE

Diamond drilling for barite was carried out by Cuvier Mines at Pine Brook, Richmond County, and by Nystone Chemical Company at Brookfield, Colchester County.

COAL

Suncor Inc., in a joint venture with Brinco Mining Limited, has completed an extensive shallow seismic survey in the Pictou County coal basin. Suncor is currently diamond drilling to evaluate a new target area.

METHANE

Novacorp Engineering Services (formerly Nova Technologies) re-entered the drilled last year in New Glasgow to clear out and stabilize caved material at the bottom of the hole.

OIL AND GAS (ONSHORE)

Corkan Engineering began a major exploration drilling program in eastern Nova Scotia. The first hole was drilled at Port Malcolm, Richmond County.

GOLD DISTRICTS DATA COMPILATION

J. M. McMullin

A geologist hired this summer under the Provincial Summer Employment Program completed a set of 8 maps that consolidated the available information on gold showings in the Province. The maps are on a scale of 1:100 000 and show the geology, NTS system (including mineral tract boundaries), boundaries of gold districts, main anticlinal and synclinal axial traces, gold showings, and mineral occurrence data (MOD) reference numbers. They also show most of the pertinent detail such as quantity veins and structure from the Faribault-Fletcher Series, Geological Series Maps; Canada Department of Mines, 1884-1929, scale: 1 inch = 1 mile.

All references to work on gold contained in the Annual Reports of the Department since 1927 have been copied and filed by individual occurrence or district, along with MOD cards, claim maps, and large scale surface plans, as well as extracts from Geological Survey Summary Reports and some Open File material. Summaries were prepared of two districts (Beaver Dam and Caribou).

These maps and files are not yet in finished form, but are available for consultation in the Stellarton office (by prior notice only). The maps will be redrafted onto transparences and can be printed as needed.

DRILL CORE LIBRARY

J. M. Bingley

The Department of Mines and Energy now maintains core storage facilities at four locations in a total of six buildings. Previous to 1983, core was stored at the office-garage complex on Bridge Avenue in Stellarton and in a converted ammunition bunker in the Debert Air Industrial Park. Additional facilities that came on stream in late 1982 and early 1983 are the former Chevron-Irving core building at Malagawatch, Inverness County and three new structures in the Stellarton Industrial Park. Total storage capacity is now some 380,000 m.

Some 124 721 m of new core was acquired in 1982-83, and large quantities continue to come in. When the present backlog is stored and manpower becomes available, we will publish a catalague of all core in storage.

Since facilities are not manned on a full-time basis, anyone wishing to examine drill core should arrange for a date well in advance (call 752-8429).

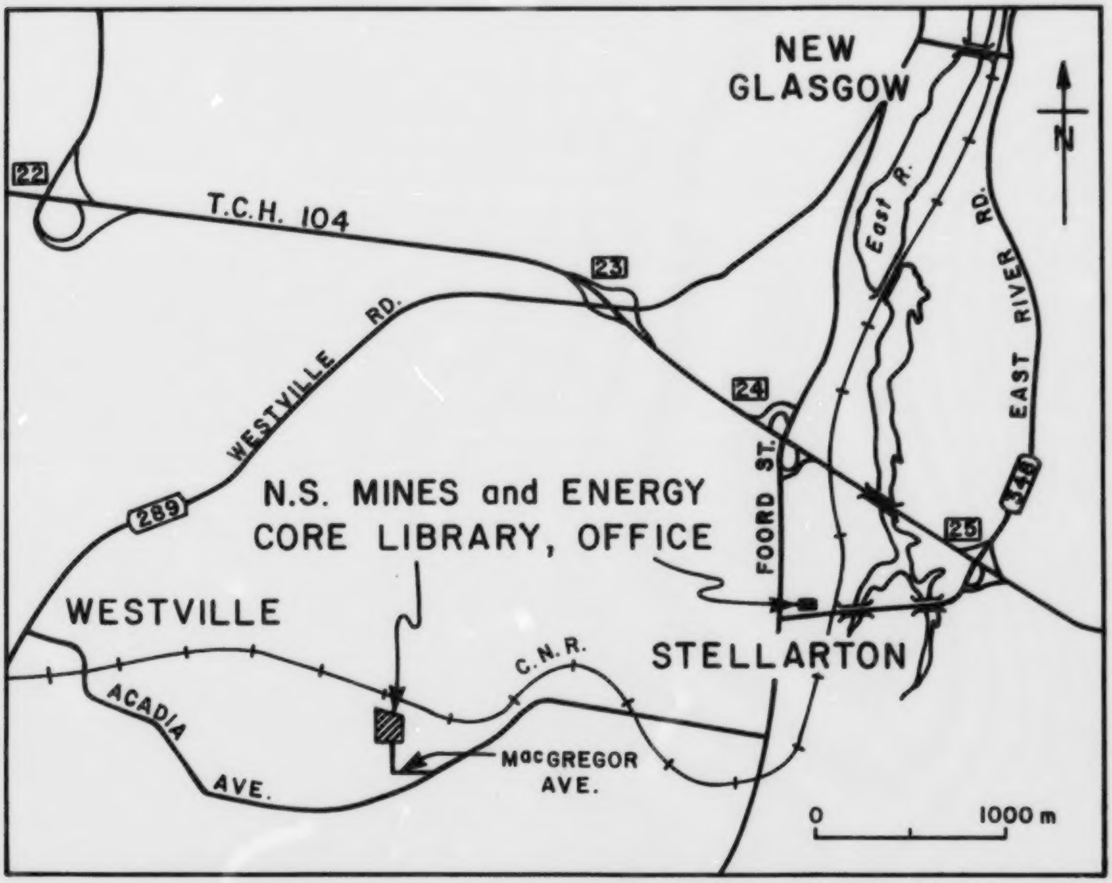


Figure 1. Location of the Nova Scotia Department of Mines and Energy core library and Stellerton office.

Drill Core Acquisitions in Departmental Core Libraries for 1982-83 (to October 1).

Stellarton Core Library

Company or Group	Location of Drilling	Amount
Coal Inventory Program	Sydney Mines, Cape Breton County	1094 m
	Springhill, Cumberland County	2697
Carboniferous Stratigraphy Program	Sydney, Cape Breton County	1013
Saarberg Interplan Can. Ltd.	Hants County	10363
E & B Explorations Ltd.	New Ross, Lunenburg County	1694
Yava Mines (Phelps-Dodge)	Salmon River, Cape Breton County	3619
Gulf Minerals Canada Ltd.	Cobequid Mtns., Colchester County	12192
	Cumberland Basin, Cumberland County	4877
	Walton, Hants County	3658
Cominco et al	Sterling, Richmond County	1524
Shell Canada Resources Ltd.	South Mountain, Kings, Digby, Annapolis Counties	11339
Noranda Explorations Ltd.	Tatamagouche, Colchester County	8120
Amax	Jubilee, Victoria County	8230
Domtar/Sifto Salt Div.	Nappan, Cumberland County Kingsville, Inverness County St. Peters, Richmond County	10363
Lacana Mining Corporation	River John, Pictou County	2159
Kaiser Celestite	Lake Enon, Cape Breton County	14857
Noval Technologies	New Glasgow, Pictou County	866
Suncor-Brinco Joint Venture	Stellarton, Pictou County	3139
Granges Exploration AB	Smithfield, Colchester County	2079
Nova Scotia Department of Mines and Energy (coal inventory)	Stellarton Pictou County	1108
Nova Scotia Department of Mines and Energy (gold project)	Holland Harbour Guysborough County	498
Nova Scotia Department of Mines and Energy (carboniferous Strat. project)	Glen Road, Antigonish County	847
Louisbourg Property Holdings et al	Gabarus Bay area, Cape Breton County	5412
Esso Minerals	Cumberland Basin, Cumberland County	1195
J. Leslie	St. Peters area, Richmond County	202
Sullivan Mining Group Ltd.	Tangier, Halifax County	317
Blockhouse Resources Ltd.	Blockhouse, Lunenburg County	634

Malagawatch Core Library

Company or Group	Location of Drilling	Amount
Chevron-Irving Joint Venture	Malagawatch, Inverness County	10625
	Total	**124721 m**

INDUSTRIAL MINERALS

J. Fowler

INTRODUCTION

Production value of industrial mineral commodities for 1983 is expected to be higher than for 1982 because of a general improvement in the economy. Again this year barite highlighted industrial mineral activity because of the demand for barite as a weighting material in drilling mud for offshore drilling programs. Along with barite, development work programs were continued or begun on dolomite, gypsum, and silica sand deposits.

Throughout the year the outlook for industrial minerals improved. Numerous requests were made for information on many commodities including: aggregates, building stone, barite, celestite, clay, diatomaceous earth, gypsum mineral filler and extenders, salt deposits (for underground hydrocarbon storage purposes), silica sand, spodumene, wollastonite, and zeolites.

INDUSTRIAL MINERAL PROGRAM, MINERAL DEVELOPMENT DIVISION

In 1983 the Mineral Development Division ran two industrial mineral field programs. One was an aggregate resource inventory mapping and sampling program in western Nova Scotia and the other was a seismic exploration and diamond drilling program to look for Cretaceous clay, silica sand, and lignite deposits.

Aggregate Resources Project

The purpose of this project was to update information on aggregate resources in selected areas of the Province. This year a field mapping and sampling program was completed in Shelburne and Yarmouth Counties of western Nova Scotia.

Deposits Studies

Deposits exceeding 125 m in thickness of clay, silica sand, and lignite of Cretaceous age are well known in several regions of the Province. Clay and silica sand found in some of these deposits are presently being mined: clay for the manufacture of building brick and silica sand for the manufacture of fibreglass insulation and glass containers. Large volumes of the silica sand is also sold as an industrial sand.

This year a two part program consisting of refraction seismic and diamond drilling was carried out to locate additional deposits. Thirty seven seismic profiles were completed along the margins of Carboniferous basins in several regions of the Province. This technique was useful in locating areas of extreme depth to bedrock where Cretaceous sediments may have accumulated and have been protected from erosion. The results of the seismic program were used to select three areas for diamond drilling. To date seven holes have been completed and the results of the program are presently being evaluated.

INDUSTRIAL MINERAL EXPLORATION AND DEVELOPMENT ACTIVITIES

Barite

Cuvier Mines completed a barite drilling program at Pine Brook, Richmond County and are drilling for base metals and barite in the old Sturgis Mine area of Hants County. Magcobar Dresser Canada have completed a diamond drilling and bulk sampling program on a barite property at Bass River. Nystone Chemicals Limited completed a diamond drilling program on the Upper Brookfield deposit. Present plans for this property are to continue producing pharmacautical grade $BaSO_4$ and begin production of drill mud grade barite. Novex Mining and Exploration Company Limited began shipping drill mud grade barite from their mill at Enon, Cape Breton County.

Dolomite

Mosher Limestone continued with development work on a dolomite deposit for agricultural purpose at Cooks Brook, Halifax County.

Gypsum

Georgia Pacific began a development drilling program on their gypsum deposit at Sugar Camp, Inverness County. Canada Cement has opened a small gypsum quarry at Upper Brookfield, Colchester County.

Silica Sand

Nova Scotia Sand and Gravel completed an exploration and diamond drilling program for silica sand at MacPhees Corner, Hants County, and Elmsvale, Halifax County.

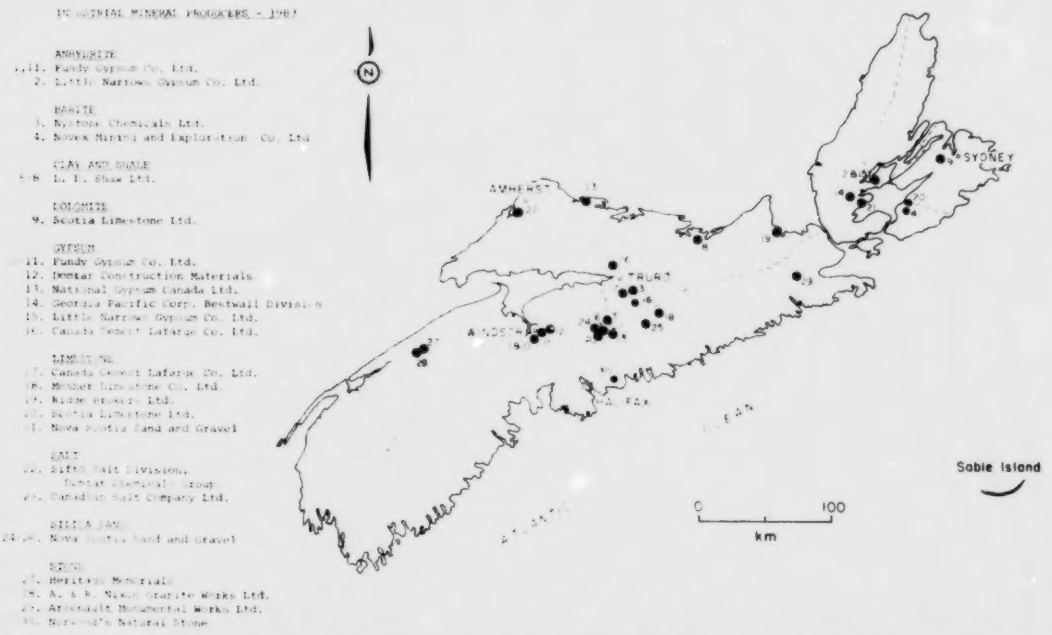

INDUSTRIAL MINERAL PRODUCERS - 1983
ANHYDRITE
1,11. Fundy Gypsum Co. Ltd.
2. Little Narrows Gypsum Co. Ltd.
BARITE
3. Nystone Chemicals Ltd.
4. Novex Mining and Exploration Co. Ltd
CLAY AND SHALE
5-8. L. E. Shaw Ltd.
DOLOMITE
9. Scotia Limestone Ltd.
GYPSUM
11. Fundy Gypsum Co. Ltd.
12. Domtar Construction Materials
13. National Gypsum Canada Ltd.
14. Georgia Pacific Corp. Bestwall Division
15. Little Narrows Gypsum Co. Ltd.
16. Canada Cement Lafarge Co. Ltd.
LIMESTONE
17. Canada Cement Lafarge Co. Ltd.
18. Mosher Limestone Co. Ltd
19. Kidde Brokers Ltd.
20. Scotia Limestone Ltd.
21. Nova Scotia Sand and Gravel
SALT
22. Sifto Salt Division, Domtar Chemicals Group
23. Canadian Salt Company Ltd.
SILICA SAND
24-26. Nova Scotia Sand and Gravel
STONE
27. Heritage Memorials
28. A. & R. Nixon Granite Works Ltd.
29. Arsenault Monumental Works Ltd.
30. Norwood's Natural Stone
N
AMHERST
TRURO
WINDSOR
HALIFAX
SYDNEY
ATLANTIC
OCEAN
Sable Island
0
100
km

Figure 1. Industrial mineral producers active in Nova Scotia during 1983.

AGGREGATE RESOURCES

W. J. Wright

AGGREGATE RESOURCES OF SOUTHWESTERN NOVA SCOTIA

The 1983 field season completed a program begun in 1982 to identify all granular and bedrock aggregate resources in southwestern Nova Scotia. This survey should provide information on the location, quality and quantity of extractable materials, and the identification of bedrock sites suitable for aggregate quarry operations.

The 1983 study area covers the counties of Shelburne and Yarmouth (Fig. 1) and includes all or parts of the following 1:50,000 national topographic map sheets: 2009, 20016, 20P5, 20P6, 20P11, 20P12, 20P13, 20P14, 20P15, 21A3, 21A4, and 21B1.

The glaciofluvial and bulk bedrock samples collected will undergo a series of tests that could include most of the following: soundness loss (ASTM C88), Los Angeles abrasion loss (ASTM C131), grading analysis, petrographic analysis (DOT N.S. Method), and organic content (ASTM C40). Test results will indicate which deposits contain aggregates suitable for the production of hot-mix asphalt and/or Portland Cement concrete.

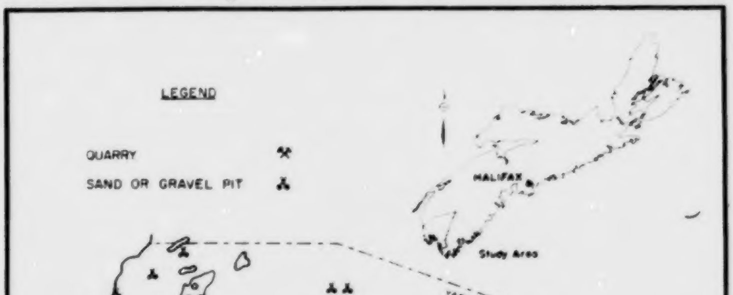
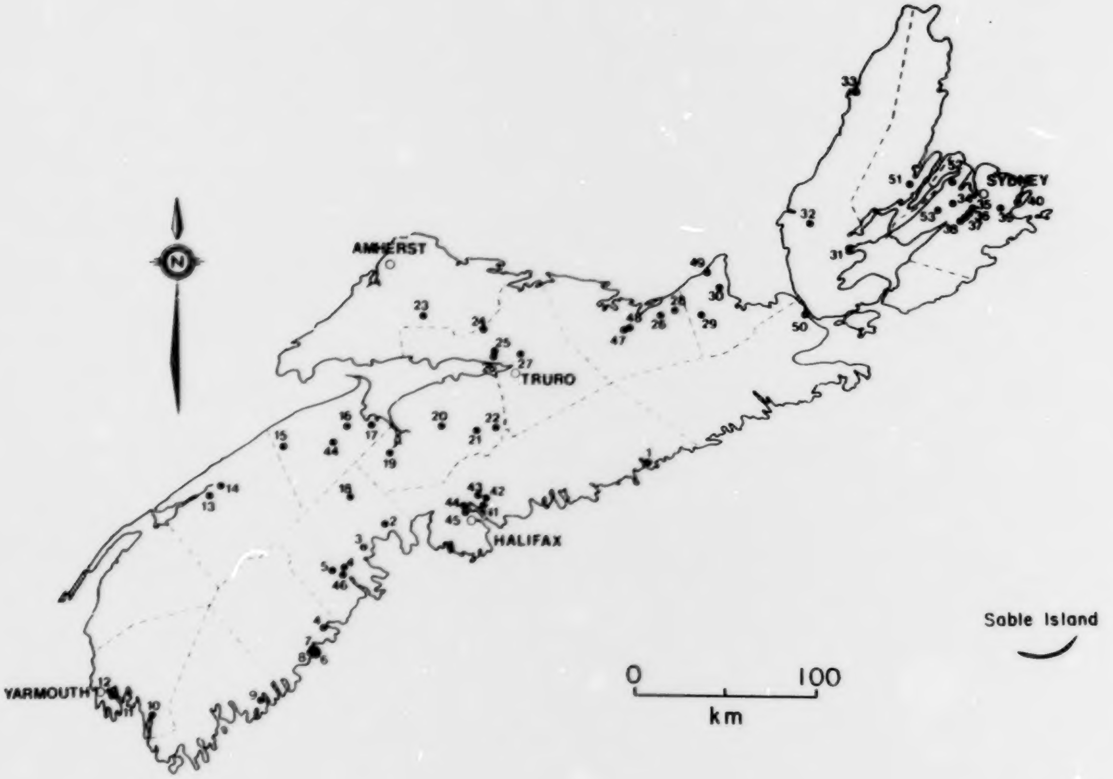


Figure 1. Locations of aggregate pits and quarries in Yarmouth and Shelburne Counties.



STRUCTURAL MATERIALS
Locations of Producers in Nova Scotia

Sand and Gravel

1. Blois V. Smith Ltd.
2. South Shore Sand and Gravel Ltd.
3. Clearland Enterprises Ltd.
4. Acadia Road Contractors Ltd.
5. Naugler Construction Ltd.
6. Everette J. Hanley Construction Ltd.
7. Mosher and Rawding Ltd.
8. Budget Paving Ltd.
9. Allister Harlow Construction Ltd.
10. Amiro and Surette Trucking & Excavating Ltd.
11. Yarmouth Concrete & Gravel Ltd.
12. Aberdeen Paving Ltd.
13. Canadian Pacific Railway
14. Clyde Everett (1972) Ltd.
15. Roy Hiltz Contracting Ltd.
16. Maurices Ready-Mix Ltd.
17. W. K. Sharpe and Son Contracting Ltd.
18. Sidney C. Hiltz Dozing and Trucking Ltd.
19. Vernon H. Shaw
20. Dexter Construction Ltd.
21. L & M Gallant Contracting, Trucking Ltd.
22. Nova Scotia Sand and Gravel Ltd.
23. Cumberland Paving and Contracting Ltd.
24. Permanent Concrete Ltd.
25. Latimer Construction Ltd.
26. Warren Maritimes Ltd.
27. Will-Kare Paving and Contracting Ltd.
28. Inter-supply Ltd.
29. Carson Enterprises Ltd.
30. Kell Enterprises Ltd.
31. Construction Aggregates Ltd.
32. Zutphen Brothers Construction Co. Ltd.
33. Chiasson Brothers Ltd.
34. Martell's Construction Ltd.
35. Malcolm S. MacDonald Co. Ltd.
36. Municipal Ready-Mix Ltd.
37. Meadows Sand and Gravel Ltd.
38. Doug Burns Excavating & Contracting Ltd.
39. G. and M. Sweeney Construction Ltd.
40. H. W. Phillips Construction Ltd.

Crushed Stone

41. W. Eric Whebby Ltd.
42. Conrad Brothers Ltd.
43. Rocky Lake Quarry Ltd.
44. Standard Paving Maritimes Ltd.
45. Gateway Materials Ltd.
46. Nauss Brothers Ltd.
47. Satellite Construction Co. Ltd.
48. S. W. Weeks Construction Ltd.
49. Colin R. MacDonald Ltd.
50. Construction Aggregates ltd.
51. Gillis Construction Ltd.
52. LaVatte Construction Co. Ltd.
53. Scotia Limestone Ltd.

Figure 2.

In addition to the bulk samples, interesting or mineralized rock samples were collected, and fines were panned from many deposits. These samples will be retained for possible future analysis.

Resistivity or seismic geophysical work may be attempted at a later date to aid in the assessment of selected deposits.

Field information has been plotted on 1:50,000 scale national topographic map sheets, and the final product will consist of 1:100,000 scale maps with a report.

Throughout the study area sand and gravel and quarry sites have been recorded and appear to be fairly well distributed (Fig. 1). In both counties, the large aggregate operations are established primarily in ice-contact deposits, whereas the smaller, seasonal operations tend to work in all types of surfical materials.

At present, most aggregate demands in Shelburne and Yarmouth counties are being satisfied, and the reserves appear adequate for the near future.

Increases in aggregate consumption are anticipated during the next few years because of the development of a new tin mine, construction of a new provincial highway system, and a program of wharf reconstruction and protection.

STRUCTURAL MATERIAL PRODUCERS

In 1979, the Nova Scotia Department of Mines and Energy began recording the locations (Fig. 2) and reporting the annual statistics on most aggregate producers in Nova Scotia.

Monitoring the growth and activities of the provincial aggregate industry is necessary because of the industries importance to the Nova Scotian economy. Although aggregate production levels have fluctuated over the past four years the value of production has increased from $28 million dollars in 1979 to $36 million dollars in 1982 (Table 1). In 1982 aggregate exceeded other important industrial mineral such as salt and gypsum both in tonnes produced and in dollar value of production.

The Department also collects and records information on concrete product and ready-mix manufactures, and silica sand, shale, and clay producers in the Province.

Table 1. Value and quantity of aggregate (crushed stone; Sand and gravel), produced in Nova Scotia, 1979-1982.

	1979	1980	1981	1982
Value ($1,000's)	27,836	28,814	34,417	36,244
Quantity (1000's metric tonnes)	10 811	10 275	11 165	8 521

MINERAL INVENTORY

N. A. Lyttle

GEOSCAN ACTIVITIES

Indexing and on-line data entry into GEOSCAN, the national data base for bibliographic geological information, continued throughout 1983 for Nova Scotia Department of Mines and Energy assessment reports, publications, and open file reports and for geoscience theses and journal literature on Nova Scotia. *Report 83-2 Index to Assessment Reports 1982 (with Keyword Index)* was released in June 1983. An Index to 1983 Assessment Reports and Index to Publications and Open File Reports for 1981, 1982 and 1983 are presently in preparation, and will be published early in 1984. An Index to Geoscience Maps of Nova Scotia is also under preparation but an early publication is not anticipated. When available, this Map Index will list all available geoscience maps on Nova Scotia organized on the basis of NTS map area, with map type , scale, year and reference cited for each map. Computer terminals, used for data entry and retrieval for GEOSCAN, have been rented for our use by EMR under the Canada-Nova Scotia Cooperative Mineral Agreement.

INDEX TO GOLD INFORMATION ON NOVA SCOTIA

Information on gold in Nova Scotia, from all available sources, is being compiled for publication of a bibliographic Index to Gold Information on Nova Scotia. The index will probably consist of two parts: a complete listing by author, and a break down by Gold District. Each Gold District will be further subdivided on the basis of author and map type. Publication of the Gold Index is expected in late 1984.

GEOSCIENCE THESES AND JOURNAL LITERATURE PROJECT

This project, in its second year of EMR funding under the Canada-Nova Scotia Cooperative Mineral Agreement, has created a public reference microfilm file of 430 geoscience theses on Nova Scotia available up to 1980. A bibliographic index to these theses, by author and map sheet, was published in *Report 81-6 Index to Publications, Open File Reports and Theses 1862-1980*. To date, 285 theses have been fully indexed and entered into GEOSCAN, and it is anticipated that a Keyword Index will be available by mid-1984. A Thesis Location Map, showing the locations of theses study areas in Nova Scotia, in preparation and should be available by mid-1984.

Compilation of geoscience journal literature on Nova Scotia has identified 810 references to date. Of these 810 references, 269 have been fully indexed and entered into GEOSCAN. When indexing and data entry are completed in the future, an Index to Geoscience Journal Literature on Nova Scotia will be published.

METALLIC MINERAL OCCURRENCES PROJECT

This project, in its second year of EMR funding under the Canada Nova Scotia Cooperative Mineral Agreement, entails the checking and updating of existing metallic mineral occurrences data (MOD) cards, and also for the creation of new metallic MOD cards. All the existing 800 metallic MOD cards have now been checked and updated, the metallic mineral occurrences lists revised, and the Metallic Mineral Occurrences Maps of Nova Scotia (Open File Report 454) also revised in light of this updating. Post-1977 geoscience documents are presently being searched for new mineral occurrences information, resulting in a further updating of the existing MOD cards, or the creation of new ones. To date, Nova Scotia Department of Mines and Energy publications and open file reports covering the period 1978 to 1980 have been processed. Presently, assessment reports covering the period of 1978 to 1980 are being searched for new mineral occurrences information.

DRILLHOLE DATA BASE PROJECT

This project, funded by EMR during 1983 as part of the Canada-Nova Scotia Cooperative Mineral Agreement, has been responsible for the creation of a computer based drillhole data base. The data base consists of 27 fields, containing information such as latitude, map sheet, mineralization, etc., on individual holes drilled in Nova Scotia, largely for the purpose of on-land exploration. The data base can be searched in any one field, or combination of fields, and the results printed out at a computer terminal. In addition, computer generated maps of drillhole locations, at variable scales, can be plotted on a drum plotter. To date, 433 assessment reports have been indexed for drillhole data, and the data base currently contains information on 5850 drillholes in Nova Scotia, covering map sheets 11D/05 to 11D/16, 11E/01 to 11E/16, 11F/02 to 11F/14, and 11K/01 to 11K/03.

OPEN ASSESSMENT REPORTS AND OPEN FILE REPORTS FOR 1983

For 1983, approximately 200 assessment reports and 40 open file reports will have been released by the year's end. All these reports will be microfilmed and will be available for consultation in the libraries of the Halifax and the Stellarton offices. These reports may also be purchased directly from Precision Microfilming Services, 6100 Young Street, Halifax, Nova Scotia, B3K 2A4 (902 455-5451).

SYDNEY BASIN PROJECT

R. C. Boehner

Geological studies of Carboniferous rocks in the Sydney Basin and Glengarry Half Graben, Cape Breton Island, continued in 1983 as part of the Canada/Nova Scotia Cooperative Mineral Program (CNSCMP). Stratigraphic and structural studies were completed in the area east of the Coxheath Hills, Sydney Harbour to Mira Bay, and south to East Bay Hills and the Mira River. Concurrently, Garth Prime completed detailed sedimentological, stratigraphical, and structural investigation of the Glengarry Half Graben (this volume). Selected sections of the Morien Group were studied in detail by Dr. Brian Rust of the University of Ottawa and Dr. Martin Gibling of Dalhousie University and by Margaret Best of the University of Ottawa.

Complementary and independent geological studies were conducted on base metal deposits in the Glengarry Half Graben area by Pierre Vaillancourt and Dr. Don Sangster of the Geological Survey of Canada, and by Dave McMullin and Dr. Sandra Barr of Acadia University on the Loch Lomond and Irish Cove plutons.

This research, supplemented by basin analysis using the entire Carboniferous succession, should permit significant advances in the geological understanding and interrelationships of the Sydney, Glengarry, and Loch Lomond area. Results from previous Sydney Basin project activities are included in reports by Giles (1983), Dilles and Rust (1983), Rust et al, (1983) and Boehner (1983).

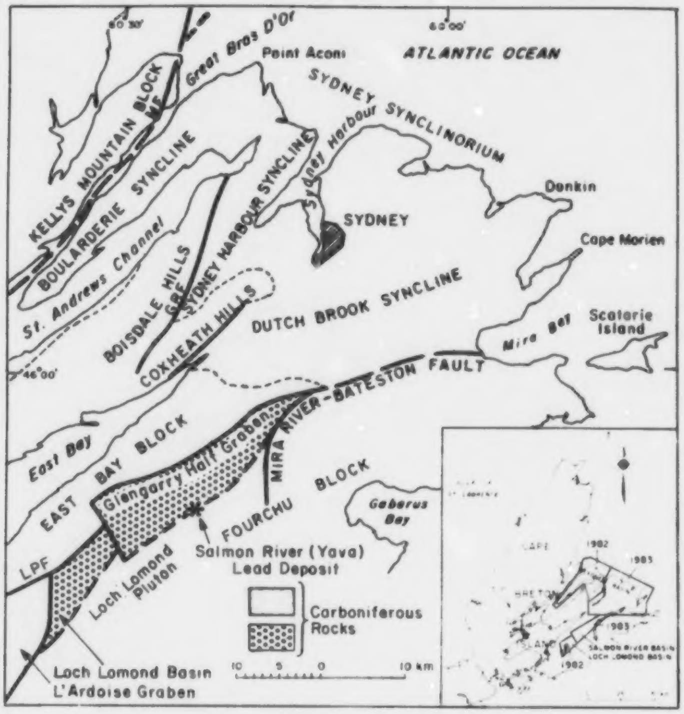


Figure 1. Location map and general geological setting of the Glengarry Half Graben southeastern Cape Breton Island.

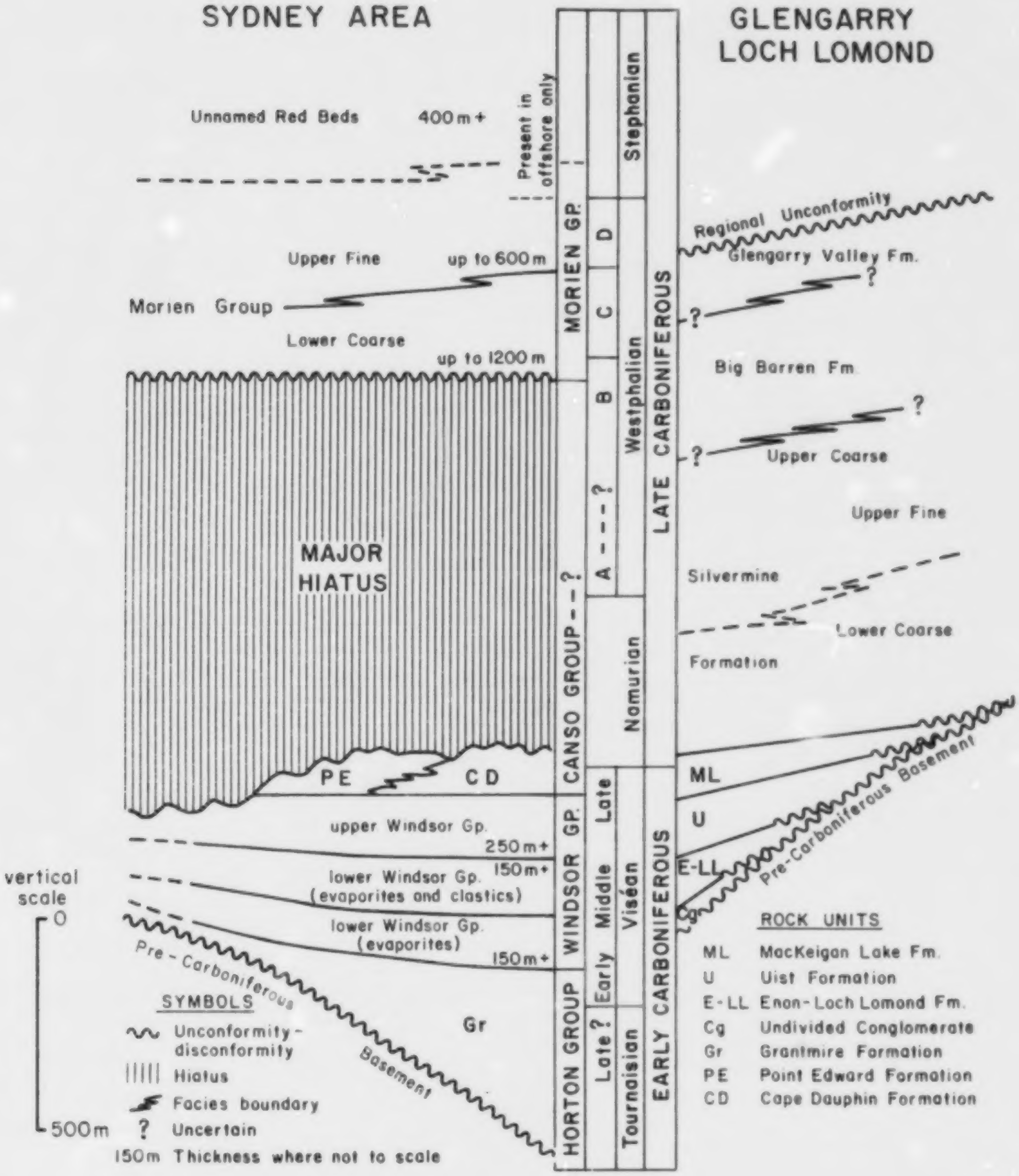


Figure 2. Summary of stratigraphic comparision between the Sydney Basin and the Glengarry Half Graben - Loch Lomond Basin.

GENERAL GEOLOGY

The Sydney, Glengarry, and Loch Lomond structural basins are situated in eastern Cape Breton Island (Fig. 1) and are bounded on one or more sides by major faults and preCarboniferous, basement rocks in the Kellys Mountain, East Bay and Fourchu Blocks. The major structures in the basins have a pronounced northeasterly trend with the larger Sydney Basin (synclinorium) containing three major synclines with intervening arches formed by preCarboniferous rocks of the Coxheath and Boisdale Hills. The Glengarry and Loch Lomond Basins in contrast are relatively simple half graben basins with a common northwest border fault. All three basins appear to represent part of formerly more extensive basins that have been dislocated by faulting.

The stratigraphic successions within the Sydney Basin and the Glengarry Half Graben Loch Lomond Basin (Fig. 2) range in age from Early to Late Carboniferous but are distinctly different in most respects -particularly in the Late Carboniferous. The two principal differences (ignoring thickness and minor facies variations) are: (1) the absence of recognizable Early Carboniferous Horton Group and the earliest Windsor Group in the Loch Lomond Salmon River Basins, and; (2) the presence of major hiatus (regional unconformity) in the early part of the Late Carboniferous in the Sydney Basin (Fig. 2). These two features are particularily useful in interpreting the paleogeographic and depositional histories of these two areas, which are now in close proximity, but have distinctive stratigraphic records.

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PRELIMINARY REPORT ON THE GEOLOGY OF THE GLENGARRY HALF GRABEN CAPE BRETON ISLAND, NOVA SCOTIA

G. Prime

ABSTRACT

Intensive exploration in the Glengarry Half Graben area of southeastern Cape Breton Island, Nova Scotia has established economic deposits of lead, celestite, and barite. Because of the importance of this Carboniferous structural basin and the large amount of data available, the present study was undertaken to develop an increased understanding of its stratigraphy and sedimentary history. Surface mapping of all outcrop exposure and logging of selected diamond-drill core were the methods employed.

Preliminary results indicate that the Glengarry Half Graben consists of approximately 2000 m of primarily continental siliciclastics, minor limnic or paralic shales, limestones, evaporites, and very minor marine carbonates. The strata are Viséan to Late Westphalian in age and occur in an asymmetric syncline. The Half Graben has a similar stratigraphy and sedimentology to the adjacent Loch Lomond Basin. In both areas the strata record a history of progressive onlap. The Glengarry Half Graben may be a remnant of a much larger depositional system.

INTRODUCTION

Description

The Glengarry Half Graben (Salmon River Basin) of Keppie (1982) is a small (125 km^2), elongate structural basin of Carboniferous age in southeastern Cape Breton Island (Fig. 1). The Half Graben is located south of the larger Sydney Basin and has a trend striking northeast. As the name implies it has the structural configuration of a half graben. To the northwest it is bounded by the Lennox Passage Fault, a northeasterly trending high angle fault separating it from the East Bay Block Hadrynian-Devonian igneous basement. To the southwest, a northwesterly trending, high angle, transverse fault separates the Half Graben from the structurally similar Loch Lomond Basin. The southeastern boundary is an angular unconformity with the Fourchu Block Hadrynian Devonian igneous basement.

Previous Work

Mineral exploration has been recorded in the area for about a century, but has been especially active during the past 20 years. In the late nineteenth and early twentieth centuries, mining operations extracted small amounts of manganese along McCuish Brook and coal at Glengarry. More recently celestite has been mined at Enon (1970-1976) and lead at Silver Mine (1979-1981). Both operations have subsequently closed due to economic problems. Presently an open-pit barite mine is in operation at Pine Brook near Loch Lomond. The intensive mineral exploration in the area has provided this project with access to voluminous subsurface information comprising approximately 25 000 m of diamond-drill core.

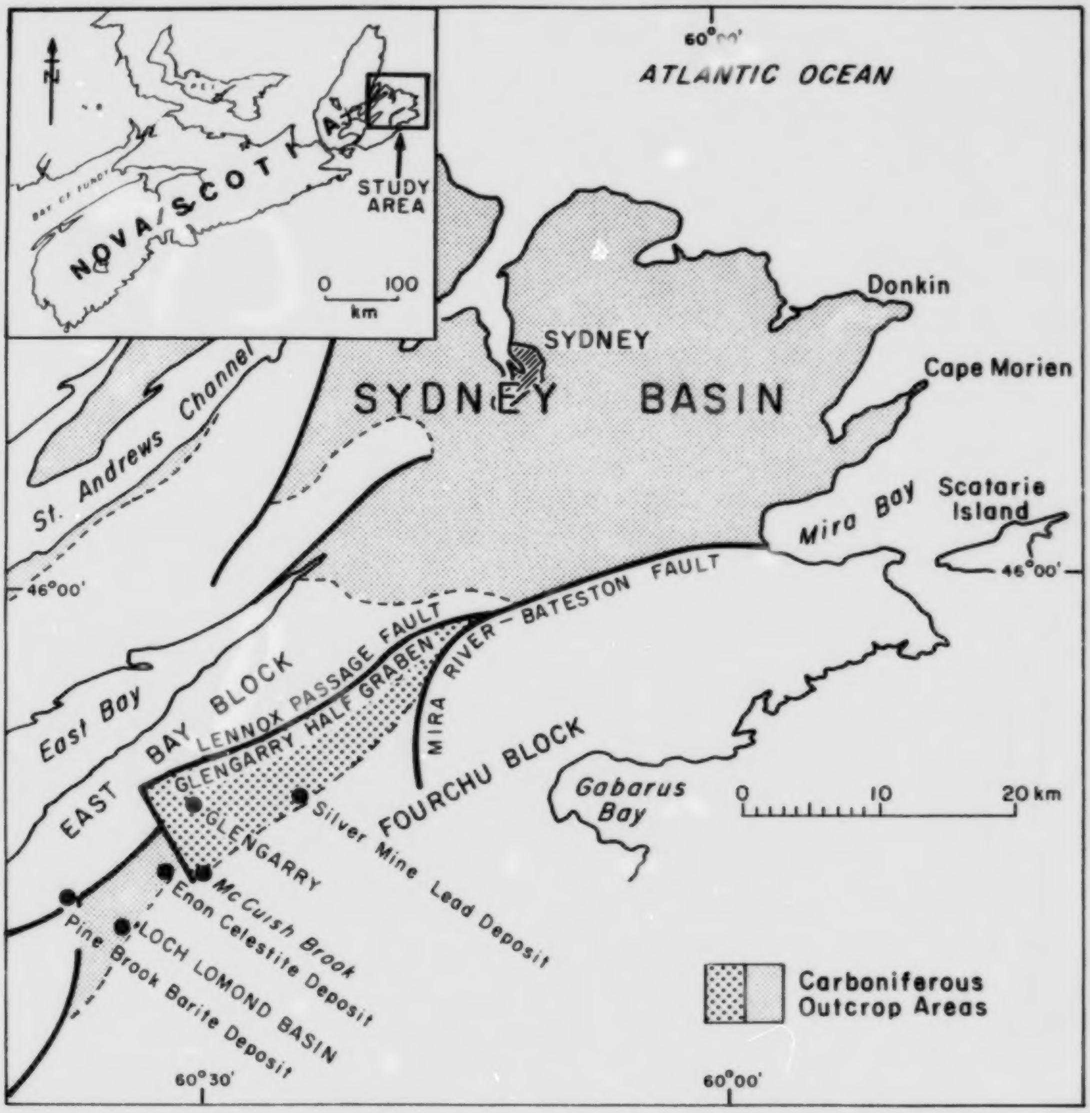

Figure 1. General geological setting of the Sydney Basin, Glengarry Half Graben, and Lock Lomond Basin. Carboniferous rocks in patterns. MF= Mountain Fault; GRF = George River Fault; LPF = Lennox Passage Fault (nomenclature modified from Keppie, 1982).

In addition to the exploration activities, several geological maps and reports on the area have been compiled (e.g. Weeks, 1954; Scott, 1978; Boehner, 1981, 1983; Keppie, 1982; Bonham et al., 1982).

Objectives and Methods

The principal objective of this study was to examine and describe in detail the stratigraphy and sedimentology of the Glengarry Half Graben. Methods employed included field mapping of all outcrop and logging of selected diamond-drill holes in a series of cross-sections. Data collected included: the measurement and description of new lithostratigraphic units to define the sedimentary history; measurement of paleocurrent readings and examination of conglomerate clast lithology to help establish provenance; and detailed sampling of sandstone for petrographic examination, shales for palynology and clay mineralogy, and coals for vitrinite reflectance. When complete the project will provide an updated geological map, a modern lithostratigraphic framework, and an increased understanding of the sedimentary history of the Glengarry Half Graben.

STRATIGRAPHY AND SEDIMENTOLOGY

The sedimentary sequence within the Half Graben (Fig. 2) consists primarily of fine- to coarse-grained continental siliciclastics and to a lesser extent paralic or limnic shales, limestones, and evaporites and marine carbonates. The age ranges from Viséan to Late Westphalian. The strata form an asymmetric syncline with beds generally dipping gently toward the centre where a maximum thickness of 2000 m is projected.

Unconformably overlying the basement on the southeast border is an intermixture of sedimentary breccia and coarse angular to subrounded conglomerate (92-140 m thick). These coarse siliciclastics represent talus breccia and proximal alluvial fan deposits, respectively. Conformably overlying this sequence and occasionally interbedded with it is brown, massive, sparsely fossiliferous dolostone (<17 m). Its precise paleoenvironment is not known, but it is considered to be of marine origin. Conformably overlying the limestone is a sequence beginning with green or red siltstone (<4 m) at the base followed by interbedded shale, limestone, and gypsum (<78 m) with the gypsum gradually disappearing and ending with fine grained red sandstone and mudstone (<33 m). The sequence indicates that arid conditions in a limnic or paralic environment existed with gradual moderation of the climate followed by replacement of standing water deposition by fluvial sedimentation. A disconformity at the top of the fine grained siliciclastic-evaporitic sequence is represented by a caliche soil. Above this is a thick sequence of medium- to coarse-grained grey sandstone (>225 m) which shows a subtle transition upward into a red, finer grained unit (>335 m) with increased mudstone. This indicates a distal braided river system gradually changing upward to a meandering river system. At the top a coarse sandstone (>60 m) appears again, representing a return of braided river conditions. Overlying the sandstone and transitional with it, is interbedded red conglomerate, sandstone and mudstone (275-700 m) representing either a proximal braided river or a braidplain. At the top of the succession and transitional with the conglomerate unit beneath, is a fine grained green-grey sandstone and shale sequence (210-300 m). This represents a combination of fluvial and limnic or paralic sedimentation.

CONCLUSIONS

The Glengarry Half Graben appears to be a remnant of a much larger sedimentary basin. The limited paleocurrent data gathered suggest that a trunk stream in the Basin was oriented in a northeast-southwest trend

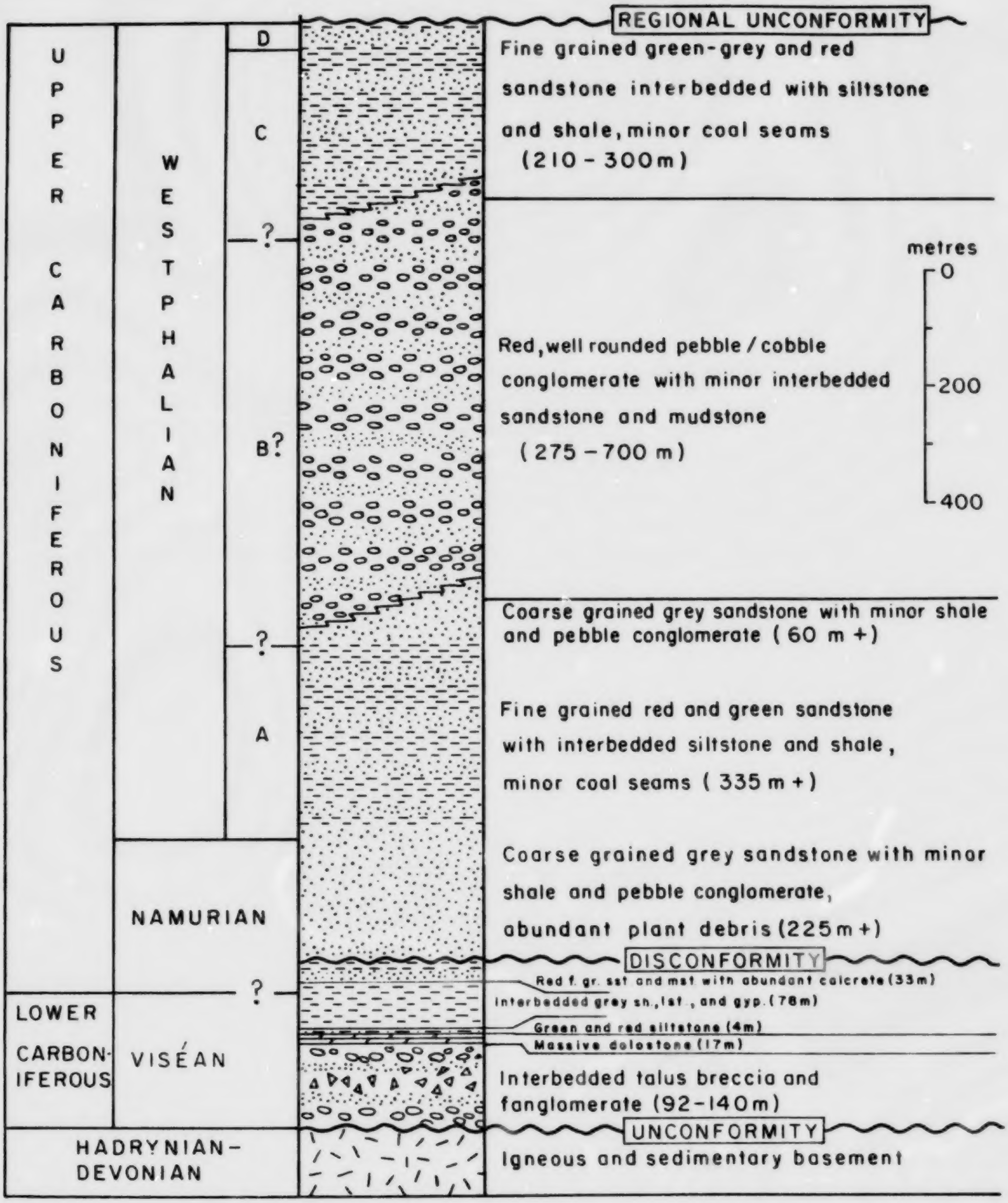
REGIONAL UNCONFORMITY
UPPER CARBONIFEROUS
WESTPHALIAN
D
C
?
B?
?
A
NAMURIAN
?
LOWER CARBONIFEROUS
VISÉAN
HADRYNIAN-DEVONIAN
Fine grained green-grey and red sandstone interbedded with siltstone and shale, minor coal seams (210 - 300m)
metres
0
200
400
Red, well rounded pebble / cobble conglomerate with minor interbedded sandstone and mudstone (275 - 700 m)
Coarse grained grey sandstone with minor shale and pebble conglomerate (60 m +)
Fine grained red and green sandstone with interbedded siltstone and shale, minor coal seams (335 m +)
Coarse grained grey sandstone with minor shale and pebble conglomerate, abundant plant debris (225m +)
DISCONFORMITY
Red f. gr. sst and mst with abundant calcrete (33m)
interbedded grey sh., lst., and gyp. (78m)
Green and red siltstone (4m)
Massive dolostone (17m)
Interbedded talus breccia and fanglomerate (92-140m)
UNCONFORMITY
Igneous and sedimentary basement

Figure 2. General stratigraphy of the Glengarry Half Graben.

throughout much of its development. Comparison of stratigraphic and sedimentological patterns with the Loch Lomond Basin indicates a strong correlation between the two. The Glengarry Half Graben strata appear to represent progressive onlap of stratigraphic units, similar to the Loch Lomond Basin.

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ICE FLOW PATTERNS IN NORTHERN NOVA SCOTIA (CUMBERLAND, COLCHESTER, HANTS AND PICTOU COUNTIES)

R. R. Stea and P. W. Finck

INTRODUCTION

This project involves mapping of the surficial deposits and glacial features in northern Nova Scotia and is part of the Canada-Nova Scotia Co-operative Mineral Program 1981-1984.

The area covered by this report lies between latitudes 45°15'N and 45°55'N and longitudes 62°45'W and 64°20'W. It consists of three physiographic regions: the Cumberland-Pictou and Hants-Colchester Lowlands, and the Cobequid Highlands (Goldthwait, 1924). The lowland areas are predominately underlain by sedimentary rocks of Early Carboniferous to Triassic age. The highland region is formed of metasedimentary, volcanic and igneous rocks of Hadrynian, Devono-Carboniferous and Early Carboniferous age that are segregated into numerous fault blocks and bounded on the south by the Minas Geofracture (Donohoe and Wallace, 1978, 1982; Keppie, 1982).

ICE FLOW PATTERNS

Figure 1 shows a plot of all striations in the map area where the sense of ice flow is known. Figure 2 depicts major features indicative of ice flow in the map area. We can see four major groupings of striation directions. The chronology of these ice flows can be deduced from the 'type localities' of crossing striation sets and stratigraphic sections of till sheets associated with these ice flows.

The oldest flow pattern trends 90°-130° throughout the map area (Fig. 1 & 2). North of the Cobequid Highlands the trend appears to have been due east. Striations and compact lodgement tills with an east-southeast striking fabric attest to the flow affecting the Cobequid Highlands. Striations under thick drift sections in the Hants-Colchester Lowlands reveal more southerly orientations. Till Unit I at Joggins (Stea, 1983) and the East Milford Till (Stea and Hemsworth, 1979) all were deposited by this early ice flow.

Striations trending 160°-210° crosscut the earlier eastward-trending set at many localities (Figs. 1 & 2). These striations are most common in the Cumberland-Pictou Lowlands where they trend south and southwest and on the Cobequid Highlands where they trend generally southward. It is not known whether these striations represent a continuous ice flow conforming to local topography and regional structure, or if they represent a chronosequence of ice flows first south-southeast then southwest in the Lowlands. Unit II at Joggins (Stea, 1983) and the Hants Till (Stea, 1982) are believed to have been initially formed during this flow event.

A strong north and northeastward ice flow occurred after the period of southward ice flow in the area. The cogent evidence for this hypothesis is as follows:

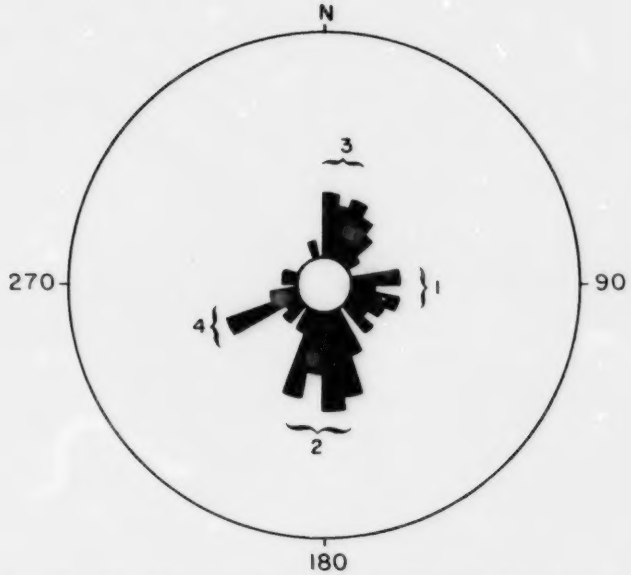

Figure 1. A plot of all the striations measured by the authors in the map area, where the sense of ice flow is known.

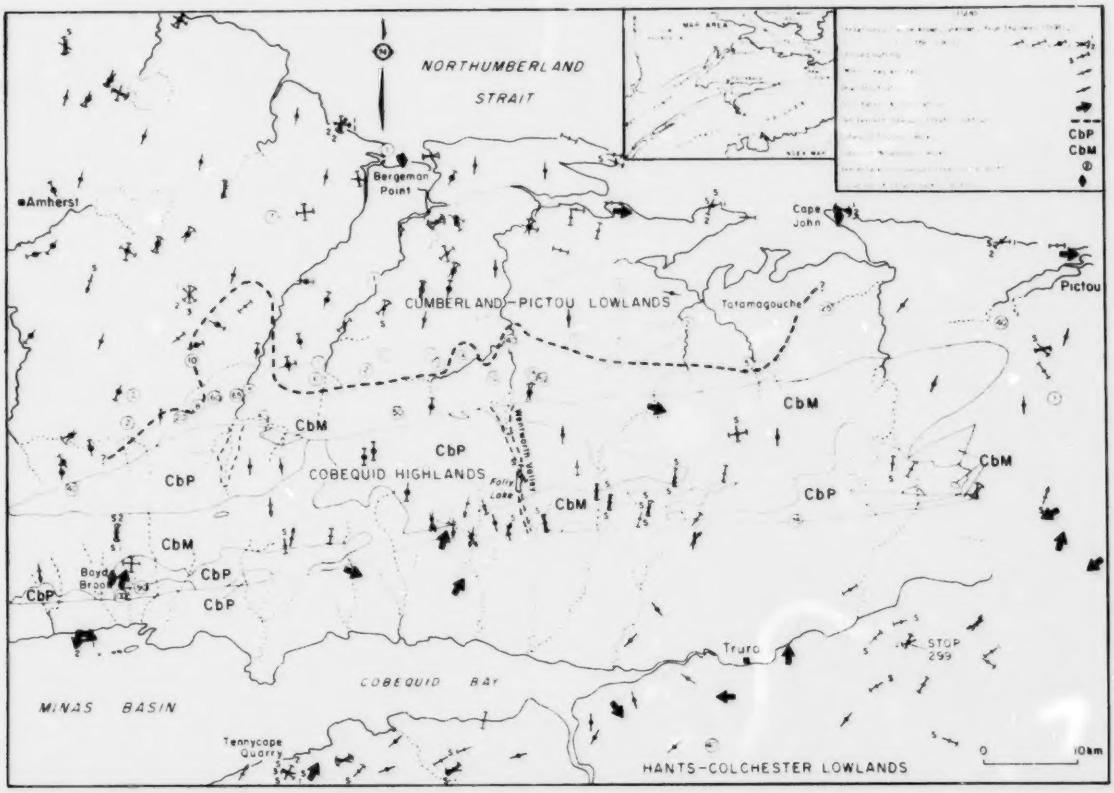

Figure 2. A map of the features indicative of ice flow in parts of Hants, Pictou, Cumberland, and Colchester Counties.

1. A till sheet and ablation boulders of Cobequid Highland provenance overlie a till sheet of Carboniferous provenance in the Cumberland-Pictou Lowlands, and Cobequid Highlands.

2. Striations trending north and northeast clearly crosscut striations trending south at many localities in the Cobequids.

The pattern of northeastward flow in the Hant-Colchester Lowlands can be traced across the southern slope of the Cobequid Highlands (Figs. 1 & 2). Since there is no apparent evidence for a limit on the southern flank of the Cobequid it is suggested that instead of a Cobequid-Centred nothward ice flow (Prest et al., 1972) the flow was initiated in a region south-southwest of the map area. A likely candidate would be the region of the Southern Uplands. This flow also emplaced granite boulders on the North Mountain cuesta (Dawson, 1868; Faribault, 1920, and Hickox, 1962). No evidence for this flow was found in the highland east of Parrsboro (Stea, 1983). The southern uplands ice may have been partially obstructed by the North Mountain and/or produced an ice shelf in the deeper parts of the Bay of Fundy. Railton (1973) termed this ice mass the South Mountain Ice Cap.

The final pulse of ice flow appears to have been westward into Cobequid Bay and the Minas Basin. Striations relating to this flow are found throughout the Hants-Colchester Lowlands and crosscut the northeastward-trending set. The source of this ice may have been in the Antigonish Highlands, west of the map area. A late southwestward movement into Chignecto Bay (Stea, 1983) may be synchronous with the westward flow into the Minas Basin. The westward flow did not appear to affect the Cobequid Highlands, which at that time may have harboured a residual, stagnant carapace of ice.

The oldest striations, trending eastward and southeastward, were assigned a Wisconsinan age by Rampton and Paradis (1981) in New Brunswick. These striations were inscribed on a wave-cut rock bench which is elsewhere assigned a Sangamon age (Grant, 1980). The East Milford Till, formed by the oldest east-southeastward ice flow, overlies peat beds with wood that gave an infinite radiocarbon age, 75, 000 years B.P. (GSC-2684). The age of the East Milford Till was speculated to be Early Wisconsinan (Stea and Hemsworth, 1979; Stea, 1982). The age of the subsequent southward and southwestward ice flow event is therefore in doubt. There is some indication of soil development on the East Milford Till (Cornish, 1980; Stea, 1982) which suggests that the southward ice flow events may have postdated a Early-Middle Wisconsinan recessional interval. The last two events, however, are probably Late Wisconsinan in age. The South Mountain Ice Cap, probable source of the northward and northeastward flowing ice, persisted into the Holocene (Railton, 1973). Hadden (1975) also invoked a persistent ice cover to explain a relatively young bog-bottom date (9187 ± 255, I-7080) in the Hants-Colchester Lowlands. She also noted that the spruce pollen maximum zone occurred 1000 years earlier in the Folly Lake area of the Cobequid Highlands (Hadden, 1975, p. 44).

On the basis of the present study the authors would modify Grant's (1977) model of Late-Wisconsinan ice distribution to accommodate a more extensive ice flow emanating from the South Mountain Ice Cap. Figure 3 summarizes the inferred sequence of ice flows in the region.

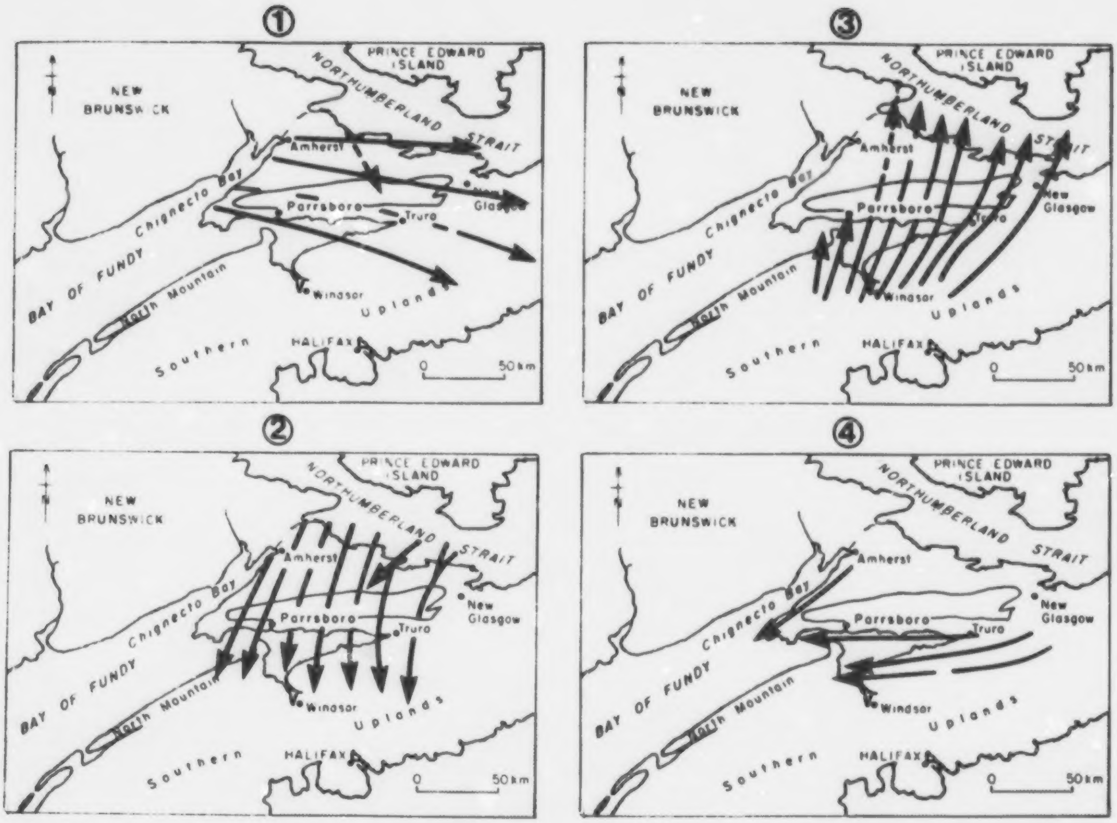

Figure 3. The inferred sequence of ice flows in the map area. Flow pattern is speculated to be Early Wisconsinan in age, flow patterns 3 and 4, Late Wisconsinan.

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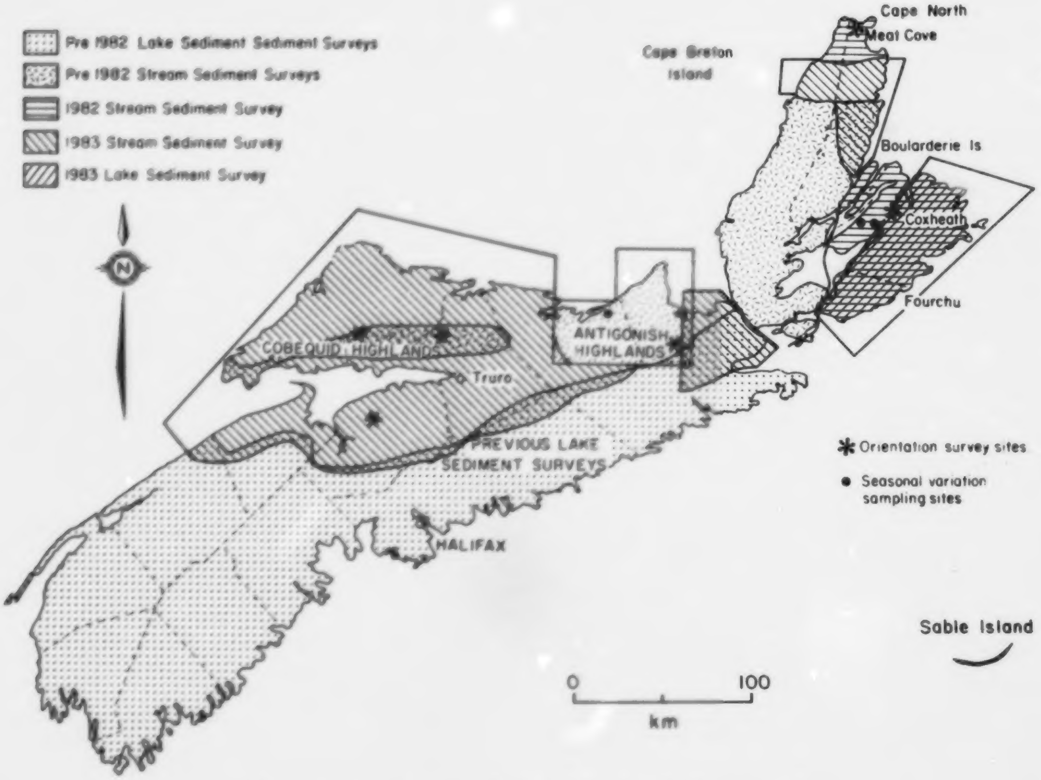
REGIONAL GEOCHEMICAL SURVEYS

P. J. Rogers and M. A. MacDonald

Regional geochemical surveys were continued in northern Nova Scotia as a joint project within the Canada-Nova Scotia Cooperative Mineral Program 1981 to 1984.

REGIONAL SAMPLING

Stream sediments, lake sediments, and stream and lake water samples were collected for the regional survey in northern mainland Nova Scotia and Cape Breton Island (Fig. 1). Further orientation studies were completed at West Gore, Debert Lake, Sugerloaf Mountain and Lochaber Lake. Stream sediment and water samples were water collected at monthly intervals from sites in Cape Breton Island and the Antigonish Highlands to monitor long term variations in trace element values.


Pre 1982 Lake Sediment Sediment Surveys
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Cape North
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Boularderie Is
Coxheath
Fourchu
ANTIGONISH HIGHLANDS
COBEQUID HIGHLANDS
Truro
PREVIOUS LAKE SEDIMENT SURVEYS
HALIFAX
Orientation survey sites
Seasonal variation sampling sites
Sable Island
0
100
km

Figure 1. Regional Geochemical Surveys.

A small pilot project was completed in which 50 sites were sampled for heavy mineral concentrates. Two 500 g samples of -1 mm silt were collected at each site. One of the sample pairs was panned to yield about 50 g of material; the other was not panned. Both samples will be washed, crushed, and passed through a magnetic separator. The heavy minerals from the 500 g sample will be obtained by heavy liquid separation. In this way, the efficiency of panning versus not panning can be tested. The highly magnetic fractions obtained will be analyzed for Fe, Ti and Cr; the slightly magnetic fraction for Fe, Cu, Ti, Cr, U, Ce and La; and the non-magnetic fraction for Sn, Mo, W, Be, As, Au, Zn, Cu, Ba, Zr, Sb, and Pb. The light fraction from the heavy liquid separation will be analyzed for Mn, Cu, Be, Pb, Zn, and Be.

The 4100 stream sediments collected from 1 cm^2 of Nova Scotia will be analyzed for Cu, Pb, Zn, Ag, Co, Ni, Fe, Mn, Mo, Hg, U, and As. Water samples collected at the same site will be investigated for U, F, and pH. The 350 lake bottom samples from the Fourchu area of Cape Breton were collected to augment on the 1982 stream sediment survey. The low relief, hydraulic gradients and inaccessible nature of the country are not well suited to regional stream sediment sampling. The lake bottom sediments will be investigated for their content of Cu, Pb, Zn, Ag, Co, Ni, Fe, Mn, Mo, U, As, V, Hg, Cd, and LOI; the waters for U, F, and pH.

ORIENTATION SURVEYS

Initial analytical results by the ICP (Inductively Coupled Plasma) technique from the Meat Cove and Coxheath orientation studies are available.

Meat Cove

The Meat Cove zinc deposit is situated about 5 km east of the village of Meat Cove, Cape Breton Island. The deposit is a magnesian skarn, consisting primarily of disseminated and massive sphalerite and lesser amounts of pyrite, pyrrhotite, chalcopyrite, galena, and magnitite (Chatterjee, 1979). The host rocks, which include interbedded siliceous dolomitic limestone and garnetiferous quartz-feldspar-biotite schist, belong to the George River group, and are interpreted as being a roof pendant in a sgenite body (Neale, 1964). From chemical traverses across the ore body, Chatterjee (1979) concluded there is a net introduction of Zn, Cu, Pb, Fe, and Hg into the wall rock surrounding the orebody. Also, Cd, As, Sn, Ge, Zr, and Ni are concentrated in the mineralized zone.

During the 1982 field season, 33 stream sediment samples from French Brook and its tributaries were collected and analyzed by Atomic absorption (AA) for Cu, Pb, Zn, Ni, Co, Ag, Mn, As, Mo, and Fe and by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) for As, Mo, Zn, P, Pb, Cd, Co, Ni, Ba, Fe, Mn, Cr, Mg, V, Al, Be, Ca, Cu, Ag, Ti, Sr, Na, and K.

Both techniques yield comparable analytical results. There appears to be a zone with elevated concentrates of Zn, Pb, Cu, Cd, Ag, Ba, Ca, and Mg adjacent to and downstream from the deposit. Conversely, elemental values for K, P, Ni, Cr, Al, Ti, V, Na and Sr, in the same zone, tend to increase with distance from the deposit. Co and Fe display erratic patterns and Mn tends to be highest directly downstream from the two faults crossing the stream.

Using threshold values from the 1975 Wreck Cove stream sediment survey indicates that anomalous zinc values occur up to 4.5 km downstream from the deposit to Lowland Cove. Anomalous Ag and Pb values may be traced up to 2 km downstream from the deposit. ICP results delineate anomalies values of Ba up to 2.5 km downstream and Cd, Fe, and Mo for the entire stream.

Coxheath

An additional orientation survey was conducted downstream from the Coxheath copper deposits using similar sample spacing and sampling techniques to those of Meat Cove. Analysis was also performed by ICP-AES and AAS.

The Coxheath deposit consists primarily of chalcopyrite mineralization in shear zones near a contact between mixed volcanics and a quartz diorite body. Chatterjee (1983) classifies the deposit as part of the Cu-Mo association which occurs in "typically I-type polyphase granitoid complexes". The ore zone has cleavated levels of B, Sc, Ci, Ni, Cr, Cu, and Zn.

Analytical results by ICP-AES and AAS indicate decreasing concentrations of Mo, Cu, Co, Zn, Ca, Na, Sr, and Mn with increased distance downstream from the deposit. Pb and As (by AA only) along with Cd, P, K, Al, Ag, and Mg have elevated concentrations only in one, two or three samples immediately adjacent to the deposit. Whereas Pb and As (ICP only) along with Cr, Ba, Ni, Be, Fe, Ti, and U generally show erratic, low overall results. Except for erratic Ni values, these results appear to be conformable to the whole rock geochemical patterns.

Using the results of the 1974 Lake Ainslie stream sediment survey to determine the background, threshold, etc., only Cu and Mo are anomalous. Cu values >25 ppm and Mo values >3.0 ppm are present up to 4 km and 3 km downstream from the deposit.

Based on the results of the two orientation surveys, the sample spacing and sampling technique should be adequate to locate deposits similar to Meat Cove and Coxheath if they occur in areas of sufficient drainage.

Initial evaluation of the Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) technique indicates that it is a useful addition to exploration geochemical techniques. In general, Zn values appear to be conformable by both ICP and AA. Pb results are comparable with less background anomaly contrast whereas Cu, Ag, Ni, Mn, Mo, and Fe all tend to have higher total concentrations by ICP versus conventional AA analysis.

MEGUMA GOLD PROJECT
EASTERN MEGUMA TERRANE, NOVA SCOTIA

INTRODUCTION

This project is part of the Canada-Nova Scotia Cooperative Mineral Program (CNSCMP) 1981-84. It is a multidisciplinary study of the area east of 62°30". J. R. Henderson (Geological Survey of Canada) along with U. Kretschmar, J. H. Crocket, P. M. Clifford, F. Fueten, A. Kabir, R. A. Stern, M. Henderson, and student assistants have mapped the area between 62°00" and 62°30" with specialist studies in certain areas. J. W. F. Waldron and L. Jensen have undertaken a ground gradiometer survey, combined with stratigraphic/sedimentological studies, in the coastal areas between Taylor Head and Indian Harbour. J. D. Keppie, S. J. Haynes, B. H. O'Brien, P. K. Smith, M. Sommer, R. Yonover, R. Farquhar, D. Dallmeyer, T. E. Krogh, G. K. Muecke, G. A. O'Reilly and L. Ham have studied various aspects of the geology in the area east of 62°00". I. J. MacEachern, R. R. Stea and P. J. Rogers have examined the till stratigraphy and geochemistry in the Forest Hill Gold District. M. Zentilli has examined the stratabound lead deposit at Eastville. The area between 61°30" and 62°30" was surveyed by the Geological Survey of Canada using an airborne gradiometer/VLF-EM (Hertz Industries BTRZ Totem 2A) and the whole area was covered by a Geological Survey of Canada radiometric survey.

Preliminary results of some of the studies are published in the Geological Survey of Canada Papers 83-1A and 83-1B, in the Nova Scotia Department of Mines and Energy Report 83-1, and in the Canadian Institute of Mining and Metallurgy Field Guidebook on "Gold Deposits in the Meguma Terrane of Nova Scotia, 1983.

Some of the study results, along with others funded under the same CNSCMP program, will be presented in a special session at the 1983 Nova Scotia Department of Mines and Energy Open House.

GEOLOGY OF THE EASTERNMOST MEGUMA TERRANE OF NOVA SCOTIA, CANADA

J. D. Keppie

The area is underlain by rocks of the Cambro-Ordovician Meguma Group, divisible into the older Goldenville Formation and the younger Halifax Formation. The Goldenville Formation is made up mainly of sandy turbidites grading upward and interbedded with thin slates and siltstones. The Halifax Formation is characterized at low grades by slate interbedded in places with thin sandstones and siltstones. Here, it is generally too poorly exposed to allow subdivision. However, at higher grades, several distict units may be recognized: a homogeneous semipelitic schist unit, a coticule (quartz-garnet layers) unit, a graphitic schist unit often ferruginous and with large chiastolite crystals, a banded quartzite/schist unit, and an andalusite schist unit.

Early structures present in the rocks of the Meguma Group range from syndepositional (flutes, ripples, grading, cross-bedding, dewatering structures such as sand volcanoes and their pipes and sheet structure, slump structures, etc.) through diagenetic (slide and slump structures, and layer parallel foliation in pelitic units) to tectonic soft sediment structures (early monoclines, and grain alignment foliation) (Keppie, 1983; O'Brien, 1983).

At some time after consolidation and before the early phase of the Acadian Orogeny a diversely oriented network of auriferous quartz veins intruded the rocks. Many veins occur preferentially in the slates, generally run parallel to the stratification but locally crosscut it. Other veins clearly crosscut the bedding and in places merge with the layer-parallel veins (Haynes, 1983; Graves and Zentilli, 1982).

The first major strain recorded by these rocks occurred during the early phase of the Acadian Orogeny (latest Early to Middle Devonian) and produced the major upright to asymmetric, subhorizontal folds associated with the development of pressure solution and slaty cleavage, with the main extension occurring approximately parallel to the fold axes. The small angular differences between several generations of minor folds, pressure solution cleavage-bedding intersection lineations, slaty cleavage-bedding intersection lineations, the long axes of sand volcanoes, and crystal fibres in extension gashes within the quartz veins result from a dextral shear component in the deformation (Keppie, 1983). This event is inferred to be a consequence of the accretion of the Meguma Terrane with the Avalon Composite Terrane and dextral movements on the Minas Geofracture (Keppie, 1982). During this event, remobilization of a variety of elements including silica and possibly gold (Clifford et al., 1983; Crocket et al., 1983) led to reprecipitation in veins in tight cylindrical to conical fold hinges (Keppie, 1976).

Relaxation of the stresses associated with the latter major event led to gravitational collapse producing a sporadic subhorizontal crenulation cleavage preferentially developed in the pelitic lithologies. In places, this event overlapped into the early part of the succeeding low pressure, Pyrenean static metamorphism characterized by the porphyroblastic, decussate growth of biotite, garnet, staurolite, andalusite and cordierite. This metamorphism is spatially associated with granitoid plutonism, and although locally a pluton may cut the metamorphic isogracts (e.g. Sherbrooke pluton, Smith, 1981) both are believed to be due to the same thermal event dated 365-375 Ma (Dallmeyer and Keppie, 1984). The general absence of gold occurrences above the andalusite-staurolite-cordierite metamorphic isograd in the southwestern Meguma Terrane suggests that the gold was driven out at the higher temperatures.

This thermal event was closely followed by another major Late Acadian deformational event (Dallmeyer and Keppie, 1984). This produced ductile deformation zones that are best developed adjacent to the Minas Geofracture. The effects of this deformation are dependent upon the lithology and the intensity of strain. In granite, a flattening foliation at lower strains is accompanied by spaced shear planes at higher strains (C-S fabric). In the Halifax Formation: (i) at lower strains, the early Acadian slaty cleavage and bedding are transposed into parallelism accompanied by rotation of bedding and slaty cleavage relative to porphyroblastic crystals, rotation of ac veins towards the bedding and cleavage and the development of steeply plunging NE-SW folds and (ii) at higher strains, a mylonitic fabric develops in places associated with a crenulation cleavage, porphyroblasts are rotated into a subhorizontal extension direction and sheath folds form. In the Goldenville Formation, strain is concentrated in the pelitic layers, which develop structures similar to those of the Halifax Formation, whereas the interbedded sandstones are only mildly deformed except at extreme strains. Kinematic analysis of these ductile deformation zones suggests they were formed by the dextral shear movements associated with the Minas Geofracture during greenschist facies metamorphic conditions. Pre-existing auriferous quartz veins are folded and/or boudinages, as they are transposed in the ductile deformation zones. Remobilization of silica and gold in these ductile deformation zones is believed to control the locations of the Cochrane Hill (Smith, 1983) and Forest Hill gold deposits.

Finally, the area was cut by a series of NW-SE sinistral brittle-ductile transcurrent faults, the largest being the Country Harbour Fault. This fault has displaced the Minas Geofracture into two segments: Guysborough County Fault and West River St. Mary's Fault. It folded the Guysborough County Fault and the adjacent ductile deformation zone between Salmon River and Country Harbour. These faults are spatially associated with sinistral NW-SE kink bands sometimes containing devitrified pseudotachylite breccia. Conjugate dextral NE-SW kink bands are present only rarely. These faults and kink bands are inferred to be contemporaneous with sinistral displacements observed on E-W shear planes. This movement is postulated to have taken place during the early Mesozoic, during formation of the Bay of Fundy Rift.

Later structures include rare conjugate, gently dipping kink bands. These are cut by both dextral and sinistral N-S fracture zones.

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STRATIGRAPHIC CORRELATION OF GOLDENVILLE SEDIMENTS BY GRADIOMETER

J. W. F. Waldron* and L. R. Jenson*

Previous sedimentary studies in the Goldenville Formation have been hampered by the lack of marker horizons in the thick sequence of monotonous sandstones and slates. Stern and Henderson (1983) carried out a magnetic survey at ground level of a part of the Formation. They showed that measurements of the vertical gradient of the total field could define stratigraphically controlled anomalies with sufficient resolution to trace individual sandstone beds and groups of beds along strike. We have used this method to subdivide and correlate rock strata within a package about 3 km thick on the south limb of the Sober Island syncline. The correlation has so far been extended about 15 km along strike between Salisbury and Baltee Islands (Fig. 1). We have also correlated this package with outcrops to the north of the Sober Island syncline.

METHODS

Lines for magnetic surveying were laid out with a Brunton compass and survey tape. Lines were selected along well-exposed coastlines and, where possible, were orientated perpendicular to the local strike of bedding. Strike parallel offsets were used to accommodate irregularities in the coastline wherever practical; elsewhere, lines oblique to strike were used. No elevations were surveyed, since survey lines were predominantly in coastal areas, with a vertical relief of generally less than 5 m. To facilitate correlation of magnetic anomalies with individual beds, tie-in points were marked at 20 m intervals along the survey lines.

An EDA-Instruments PPM-500 Vertical Gradient Magnetometer was used to measure total field and vertical gradient at 2 m intervals along the survey lines. The results were plotted during the field operation, using an HP85 desk-top computer at the field camp.

The vertical gradient magnetometer consists essentially of two total field proton magnetometers mounted 1 m apart in a single vertical pole. The value recorded is the difference (in gammas) between the two total field values. Compared with a conventional magnetometer, the instrument emphasizes the magnetic effects of near-surface bodies and steeply dipping layers, and is thus particularly suited to differentiating exposed units that differ in their magnetization but appear lithologically uniform. Under such circumstances the instrument can resolve anomalies separated horizontally by as little as 5 m. The amplitude of the anomalies falls rapidly with distance from source, so that traverses across overburden produce relatively flat profiles. Even in such intervals, however, the resolution provided by the vertical gradient is found to be superior to that of the total field data, although the reduced amplitude makes correlation more difficult.

We found adequate correlation in the area of Figure 1 could be achieved with fairly closely spaced (1-3 km) traverse lines, but needed

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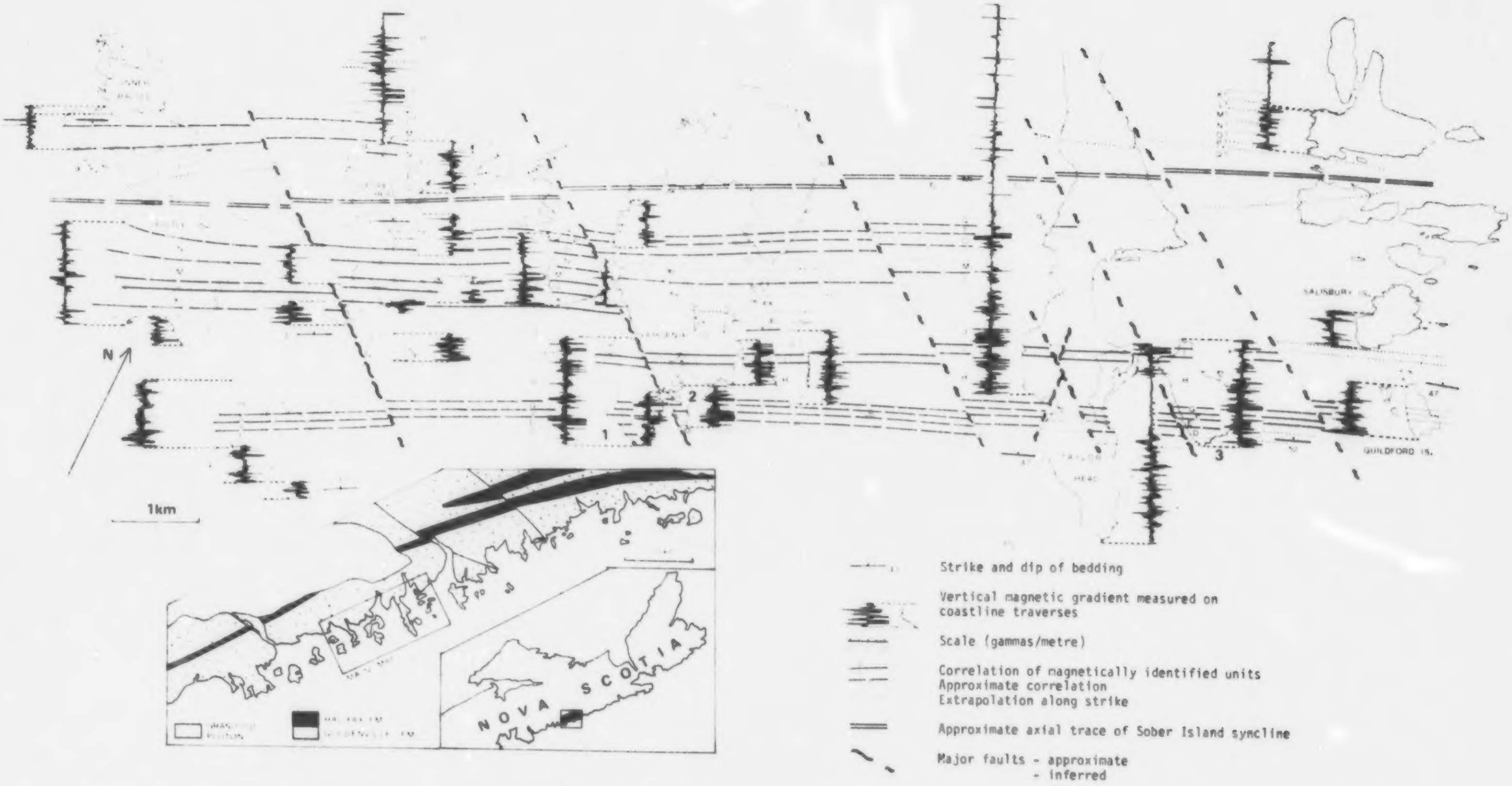
N
1km
1
2
3
SALISBURY IS.
GUILDFORD IS.
TAYLOR HEAD
47
NOVA SCOTIA
HALIFAX FM
Strike and dip of bedding
Vertical magnetic gradient measured on coastline traverses
Scale (gammas/metre)
Correlation of magnetically identified units
Approximate correlation
Extrapolation along strike
Approximate axial trace of Sober Island syncline
Major faults - approximate
- inferred

Figure 1. Map of area densely covered by vertical gradient magnetometer traverses, showing proposed correlations and inferred magnetically characterised subdivisions C to Q. Strike of boundaries taken from aerial photographs, field measurements, and map of Sober Island syncline core produced by Harris (1971). Many minor faults not shown.

to use aerial photographs to determine strike and locate major faults. In less well exposed areas, a much denser spacing of survey lines would be needed for unambiquous correlation. No correction could be made for the effect of topography, which undoubtedly influenced some readings. When positive features coincided with steep topographic slopes, a large adjacent negative anomaly was frequently recorded, whereas large negative gradients were rare on level ground. The results thus contain effects of local topographic features that modify the shapes and amplitude of some anomolies. No attempt has been made, therefore, to model the magnetic properties of individual layers, since this would require precise topographic surveying along and adjacent to the traverse lines.

RESULTS

Figure 1 shows the region between Salisbury and Baltee Islands where a package of the Goldenville Formation about 2.5 km thick is particularly well exposed. The top of this package lies about 1.5 km below the top of the Goldenville Formation, according to the cross-section of Harris (1971). A number of conspicuous features on the magnetic profiles allow subdivision of the package on the south limb of the Sober Island syncline into about 15 stratigraphic units. Correlation with the north limb of the syncline is more tentative; outcrops were relatively poor on south-dipping fold limbs throughout the area studied, possibly owing to the plucking effects of south-flowing ice during glaciation.

Throughout the area, large positive gradients are clearly associated with packages of thickly bedded sandstone. This supports Stern and Henderson's (1983) attribution of the magnetic anomalies to a detrital component (magnetite) in the sandstones. Nevertheless, some thick sandstones do not correspond to major peaks; the magnetic profiles cannot therefore be used to map lithologies or facies directly.

The correlation of vertical gradient profiles provide good control of the apparent offset of a number of faults, most of which can be accurately located on aerial photographs. Small thickness changes can be seen in some units as they are traced along strike; in general, it is not possible to determine whether these variations are primary or tectonic in origin, but the disappearance of a conspicuous interval of negative gradients west of Phoenix Island is almost certainly the result of localized erosion prior to the deposition of a large lenticular sand body.

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GOLDENVILLE FORMATION, EASTERN SHORE: PRELIMINARY SEDIMENTOLOGICAL RESULTS

L. R. Jenson* & J. W. F. Waldron*

INTRODUCTION

The Goldenville Formation is particularly well exposed in the area shown in Figure 1, (Waldron & Jensen, this volume) where Harris (1971) was able to trace certain beds along strike between Phoenix Island and Taylor Head. We have been able to extend this correlation both laterally and vertically, using a vertical gradient magnetometer to identify marker horizons, and have carried out a sedimentological field investigation based on these results. Interpretation of the data in this investigation is still in progress; in this report we briefly describe the principal sedimentary facies present. We do not here propose any comprehensive model for the depositional system, since a large volume of data collected in the 1983 field season remains to be analysed.

The Goldenville Formation in the area of Figure 1 consists predominantly of grey to greenish-grey, poorly sorted, fine- to medium-grained sandstones, in which an originally clay-rich matrix is altered to metamorphic chlorite. There are occasional coarser sandstones and granule conglomerates. The sandstones occur in beds from 1 cm to several metres thick, although amalgamated packages may be over 50 m in thickness. The sandstones show a variety of sedimentary structures including sole-marks, abundant parallel lamination, various types of cross-stratification, bioturbation, and water-escape structures. Interbedded greenish slates make up less than 30% of the sequence.

Previous workers have suggested a deep-marine, turbidite origin for the sandstones. Schenk (1970) proposed that turbidity-current deposits had been extensively reworked by contour-following bottom currents. Harris (1971), in a study of the Taylor Head area (Fig. 1), described the various sedimentary structures in detail and postulated deposition mainly by turbidity currents. Schenk (1973) equated the facies of the Goldenville Formation with mid-fan deposition in the submarine fan model of Walker and Mutti (1973), and suggested grain-flow and fluidized-flow as possible depositional mechanisms in addition to turbidity currents.

SEDIMENTARY FACIES

We have adopted a preliminary classification of the sediments into seven main types.

Intraclast Conglomerate

This type of sediment is restricted to a few horizons within the sequence investigated. It consists of predominantly angular argillaceous clasts ranging from a few centimeters to 2 m in length, within a matrix that varies from medium sandstone to granule conglomerate. The beds range from 3 to 10 m in thickness and are associated with thick, massive and cross-laminated sandstones.

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Internally-Scoured Sandstones

These sandstones commonly occur in amalgamated packages, within which recognizable depositional units range from 2 m to 10 m in thickness. The most characteristic sedimentary structures are large flute-like scours typically about 0.15 m deep, 0.35 m wide, and 0.8 m long. These are filled with cross-laminated sandstone.

Frequently, the scoured portion overlies generally finer, parallel or wavy-laminated sandstone that sometimes shows inverse grading near the base of the layer. Above the scoured interval, cross-lamination usually gives way in turn to wavy lamination, parallel lamination, and/or massive sandstone with abundant dewatering pipes and sheets, and occasional vertical burrows. Grading is confined to the top few centimeters. Sand volcanoes or ripple marks may develop at the top surface.

The internally-scoured sandstone were clearly rapidly deposited by fast-flowing currents. Multiple scours imply repeated erosion and deposition, suggesting major fluctuations in current velocity within each episode.

Laminated To Massive Sandstone

This is the most common type of sandstone found in the area studies. The beds range from 0.4 m to 3.0 m thick. Typically such beds may be divided into two portions. The lower portion, about one third of the total thickness, is characterized by parallel to wavy laminations, low-angle cross-laminations, or (rarely) by massive sandstone. The upper portion is usually massive, but contains vertical or steeply inclined pipes or sheets of slightly coarser, better sorted sand. More rarely, this interval shows convolute lamination or pseudonodules, parallel lamination and/or dish-structures, and mudstone intraclasts. Sand volcanoes are common to the top surface.

Laminated to massive sandstones again indicate rapid deposition under high energy conditions. Homogenization of the upper parts of the beds was primarily due to water escape.

Graded Sandstones

These sandstone beds show continuous grading from base to top ranging from 0.05 m to 1.0 m thick. The sandstones are usually parallel laminated and pass up into ripple-drift cross-laminated silts. Their sequences of sedimentary structures can be accommodated within the Bouma sequence, characteristic of "classical" turbidites.

Muddy Sandstone

This category includes a range of sediment types characterised by the presence of very poorly sorted, highly cleaved, muddy sandstone. Within this sediment, fine sandy and shaley laminae are often highly contorted, probably as a result of slump folding. They are interpreted as products of sediment remobilization by local down-slope movements.

Cross-Laminated Slate

This material consists of cross-laminated silt beds from 0.005 to 0.2 m thick, intercalated with finer slate. Parallel or cross-laminated sand appears rarely at the base of the cross-laminated silt beds.

Laminated Slate

Fine-grained slates occur between sandstones of all types and intercalate between cross-laminated silts. Most slate intervals show occasional parallel laminations or isolated, slightly coarser laminae, but some are apparently homogeneous.

LATERAL CONTINUITY AND VERTICAL SEQUENCES

Equivalent sections correlated by means of the gradiometer, show considerable lateral variability of the sand beds. The following features have been noted: (1) Basal surfaces of major amalgamated sand packages frequently cross-cut underlying units, suggesting major channelization of the sandstone packets. (2) Short (4-20 m) sequences may show either thinning-and-fining-upward cycles or thickening-coarsening-upward cycles. Such cycles are usually equated with specific environments in submarine-fan models (e.g. Walker and Mutti, 1973), but are also known to occur in other environments. Further work on data collected in the 1983 field season will concentrate on an analysis of these vertical and lateral facies relationships in order to arrive at a better understanding of the depositional system.

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AEROMAGNETIC GRADIOMETER SURVEYS IN MEGUMA TERRANE

Peter Hood*

For the past decade the aeromagnetic survey group at the Geological Survey of Canada (GSC) has been developing a new airborne magnetic survey technique that measures the vertical gradient of the earth's magnetic field, as well as the total field itself. The vertical gradient technique has a number of distinct advantages, summarized as follows:

(1) superior resolution of anomalies produced by closely spaced geological formations;

(2) anomalies produced by near surface features are emphasized with respect to those resulting from more deeply buried rock formations;

(3) direct delineation of vertical contacts by the zero gradient contour value, i.e. vertical contact mapper; and

(4) regional gradient of the Earth's magnetic field and diurnal variation are automatically removed.

The GSC Beechcraft Queenair aircraft was equipped in 1973 with an aeromagnetic gradiometer and a series of experimental surveys were carried out to demonstrate the efficacy of the vertical gradient technique for detailed geological mapping and mineral exploration programs.

A number of aeromagnetic gradiometer surveys have been flown on behalf of the Department of Mines and Energy, specifically in the Halifax, Yarmouth, Antigonish and Guysborough County areas. The earlier surveys were supported by DREE - funding, but the last survey, completed in July 1983, was a contribution to the Canada-Nova Scotia Cooperative Mineral Program.

In general, the vertical gradient surveys demonstrated very well the various advantages of the technique and the fact that the vertical gradient map, in their colour-contoured form, may be directly utilized as a pseudo-geological map. For instance, the various bands comprising the Halifax slate are much better resolved, and the slate's contact with the Goldenville Formation is easily determined. The magnetic halos produced by the Devonian granite are clearly apparent. A number of faults previously mapped can be easily extended, using the vertical gradient data. Others, not previously mapped, can be readily deduced because they produce magnetic lows, nick-points, and/or offsets in the contours.

The success of the aeromagnetic gradiometer development program has led to a transfer of the technology so that Canadian airborne geophysical contractors can offer such surveys commercially. As a result, the first commercial aeromagnetic gradiometer survey contracted by the GSC has been carried out in the Mahone Bay area of Nova Scotia by Kenting Earth Sciences Ltd. of Ottawa, under the Canada-Nova Scotia Cooperative Scotia Cooperative Mineral Program.

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*Geological Survey of Canada, Ottawa

A DYNAMIC ANALYSIS OF FOLDING AND FRACTURING DURING GREENSCHIST FACIES METAMORPHISM, MEGUMA TERRANE, NOVA SCOTIA

B. H. O'Brien

The Acadian deformation of Meguma Group sandstones and shales in the chlorite and biotite zones of regional metamorphism in eastern Nova Scotia is interpreted kinematically in terms of bedding-parallel shear and bedding-parallel shortening with subsequent gravitational collapse along upright cleavage. The principal stresses appear to have been inclined with various angles to bedding at any one place and at any one time. The orientation and relative geometry of the sealed joints and small faults suggest that they relate to the same stress fields that produced the major folds. Shear and tensile fractures developed prolifically during buckling before, during and after the development of vertical pressure solution and slaty cleavages.

Cleavages and vein-filled joints are sensitive indicators of flexural slip and neutral surface folding. Where there is evidence that such mechanisms were operative, a commonly observed sequence is one of (a) fracturing of sandstone and shale, (b) infilling of the fracture, (c) folding of the fracture infilling, (d) refracturing of host rock and vein. Strains documented by cleavages and folds point to quasiplastic behavior during this cycle, while joints with chloritized arrest structures indicate failure under elastico-frictional conditions. It seems that the deformation repeatedly shifted from the seismic to aseismic mode and vice versa.

STRUCTURAL HISTORY OF THE MEGUMA TERRANE IN NOVA SCOTIA FROM SHEET HARBOUR TO SHERBROOKE

J. R. Henderson*

The Cambro-Ordovician Meguma Group metasandstone and slate beds (up to 3 m thick) are folded on wavelengths of 6-10 km. Fold limbs are straight; strike east-northeast and dip 50° to 90°. Hinges plunge gently; hinge regions are flattish with M- and W- shaped profiles. South limbs of anticlines are steeply dipping and commonly overturned. North-south compression initially was accommodated in three ways: (1) shortening by volume loss evidenced by east-striking pressure solution cleavage, (2) vertical extension by hydraulic fracturing indicated by crack-seal texture in bedding-parallel quartz-chlorite veins, and (3) east-west extension by ductile flow in metasediments indicated by boudinage of the veins and elongation of sand volcanoes. Subsequent rapid fold amplification took place mainly by bending of sandy beds and flexural flow within finer grained beds. High strain rates and fluid pressures in slate beds on fold limbs produced en echelon tension gash veins showing various degrees of rotation from their original 45° angle with bedding. Transposition of the early-formed cleavage towards parallelism with bedding is greatest in steeply dipping and finer grained rocks. Subsequent to flexural folding, renewed pressure solution allowed post-flexure tightening of folds. During amplification by flexure, folds propagated along strike and (1) linked in phase with other folds to form long cylindrical folds, or (2) formed short en echelon folds by stepping left (or right) one-quarter wavelength, or (3) terminated in an abrupt conical fashion where out-or-phase folds abutted. In a 10 km wide zone extending south of the normal fault at the northern margin of the Meguma Terrane, metamorphism decreases from staurolite to chlorite grade, and the Meguma Group is intruded by granites of two ages. The earliest granite is concordant and contains fabrics indicative of dextral shear on planes striking east-northeast and dipping steeply north. The shear plane cleavage overprints the pressure solution cleavage in Meguma metasediments. Discordant granite truncates the sheared granite. Lower Carboniferous fanglomerate (Horton Group) in the graben north of the fault contains boulders derived from both granites.

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GEOLOGY OF THE SANGSTER LAKE, LARRY'S RIVER, AND FOREST HILL GRANITOID PLUTONS

G. A. O'Reilly

INTRODUCTION

During the 1983 field season selected granitoid plutons of the eastern Meguma Terrane were mapped as part of the Meguma Project of the Canada-Nova Scotia Co-Operative Mineral Program, 1981-1984 (Fig. 1). The Sangster Lake and Larry's River plutons were mapped in detail at 1:15840 as they have good outcrop exposure and interesting variations in airborne gamma ray spectrometric response (Ford and Ballantyne, 1983). The airborne data and follow-up reconnaissance lithogeochemical sampling of Ford and Ballantyne indicated some of the granitic plutons of the eastern Meguma Terrane are in the specialized granite class described by Tischendorf (1977). To supplement the detailed mapping, the granitic plutons in the Forest Hill area (Fig. 1), which for the most part are poorly exposed, were sampled on a reconnaissance level. These samples were compared with the results of detailed mapping of the Sangster Lake and Larry's River plutons.

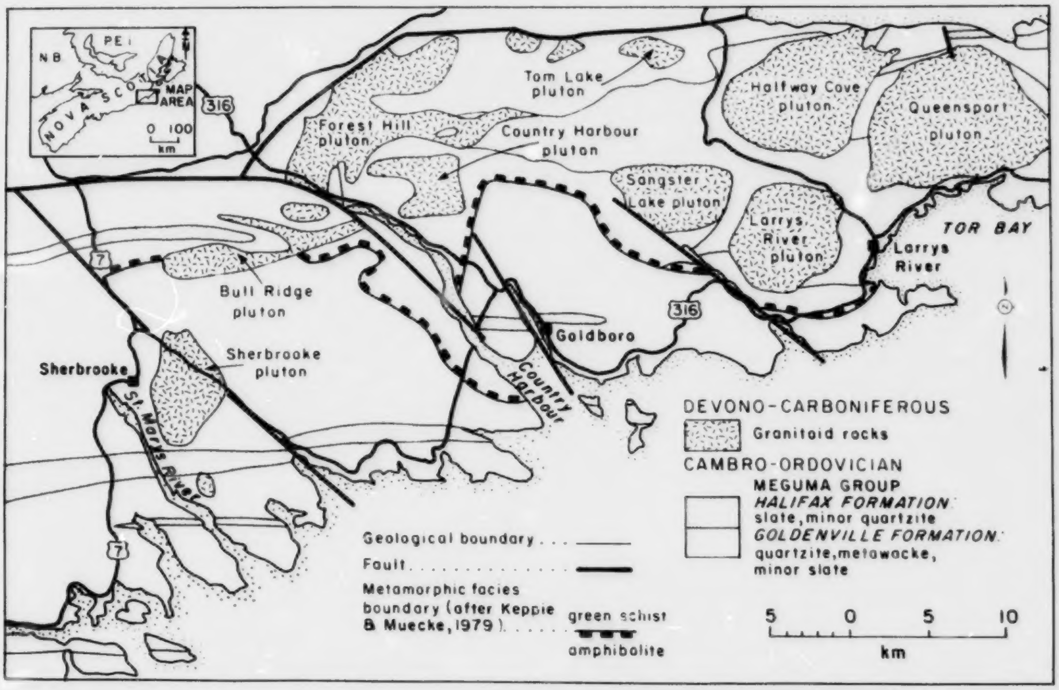

Figure 1. Geology and pluton location map of the Eastern Meguma Terrane.

SUMMARY OF MAPPING

Field identification suggest that the granitoid plutons range in composition from biotite granodiorite to two mica monzogranite, although lesser intrusions of muscovite granite, leucogranite, aplite, and pegmatite occur. A transitional monzogranite phase defines a gradational contact between the biotite granodiorite and two mica monzogranite. Texturally the plutons vary from coarse grained porphyritic phases (granodiorite and transitional monzongranite) to coarse-medium grained hypidiomorphic granular phases (two mica monzogranite and leucogranite).

The least differentiated granodiorite phase, at present believed to be the oldest phase overprints regional metamorphic amphibolite facies assemblages in its contact aureole. Shear related deformational fabrics occur variably throughout some of the granitoid plutons. This variation in distribution and intensity of deformation is believed due to localization of shearing along distinct belts which occur throughout the north and east of the area. Another explanation for this variation in deformation may be due to existence of different ages of granitic intrusion. These alternatives are to be tested by radiometric age determinations.

The airborne gamma ray spectrometric data of Ford and Ballantyne (1983) show distinct distribution patterns of uranium and thorium over the granitoid plutons of the region. To a limited extent elevation in levels of uranium and the eU/eTh ratio are correlative with increased magmetic differentiation from granodiorite-monzogranite. Within plutons of predominantly monzogranite (eg. Sangster Lake and Forest Hill plutons) these increasing trends in the airborne radiometrics systematic do not correlate with highly differentiated plutons of muscovite granite and leucogranite. The muscovite granite and leucogranite are highly obviously evolved and are often hosts of obvious increased pneumatolytic-hydrothermal activity. This is evidenced by the presence of tourmaline greisen, ablitization, and extensive quartz vein zones. These highly differentiated plutons cannot be distinguished from monzogranite using the airborne radiometric data. Therefore the radiometric signiture of the granitoids may only be reliable on a regional scale for designation of potential "specialized granitoids". For actural delineation of exploration targets care should be used in interpretation of the radiometric data.

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THE HALFWAY COVE-QUEENSPORT PLUTON, GUYSBOROUGH COUNTY, NOVA SCOTIA

Linda Ham*

The granitoid pluton, located at approximately 45°16' to 45°21'N latitude and 61°14' to 61°30'W longitude, N.T.S. 11F/06C, is of particular interest within the Eastern Meguma Terrane because of its proximity to the Minas Geofracture. This Devono-Carboniferous pluton is an irregularly shaped pluton with two lobes which may or may not be chemically distinct, but can be generally classified as the "Halfway Cove Pluton" (the western lobe) and the "Queensport Pluton" (the eastern lobe). The northern edges of the two lobes lie immediately south of the Minas Geofracture and the eastern edge of the "Queensport Pluton" closely borders Chedabucto Bay.

The pluton is comprised predominantly of two-mica monzogranite and biotite granodiorite. An oversaturation of alumina is evident with the presence of biotite and some garnet. There are several different phases indicated within each lobe. Within the "Halfway Cove Pluton", there is a predominant coarse-grained, two-mica monzogranite phase with later minor aplitic and pegmatatic phases, and minor earlier secondary phases of medium grained two-mica monzogranite and biotite granodiorite. The "Queensport Pluton" consists of a coarse to medium grained hypiodiomrophic two-mica monzogranite phase and an earlier coarse grained, intensely porphyritic monzogranite phase, with minor granodiorite. A transitional monzogranite occurs within both lobes, commonly defining a gradational contact between the minor biotite granodiorite phase and the two-mica monzogranite phase. Minor greisens occur, concentrated closely with the shearing and fracturing presumably related to the Minas Geofreacture. Limited greisenization is also associated with other fractures within the pluton.

Foliation and deformational fabrics within both lobes may be attributed to the following two processes, (1) weak shearing related to any different ages of magmatism, and (2) strong localized shearing, due predominantly to the movement related to the Minas Geofracture and other belts of possible movement. Both lobes exhibit intense foliation within the rocks closest to the Minas Geofracture. This foliation and deformation is indicated by alignment of biotite and stretched quartz and feldspars, and decreases with distance from the fault.

The Halfway Cove - Queensport Pluton does not appear to have significant amounts of the later and more highly evolved phases, such as muscovite granite or leucogranite, which are commonly associated with economic mineralization in other peraluminous plutons throughout both Nova Scotia and other parts of the world. Boulders of both these phases are seen close to the southern contacts of the lobes. Several small roof pendants of the Cambro-Ordovician Meguma metasedimentary rocks are evident close to both the northern and southern contacts of the pluton, which may be economically important considering the relationship of the roof pendants with the uranium occurrences within the New Ross-Vaughn complex within the South Mountain Batholith. A horseshoe-shaped radiometric high of thorium to uranium within the "Queensport Pluton" correlates approximately with the intensely prophyritic phases. Additional evidence and explanation for the increased level of thorium may be found with further analyses.

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GEOLOGY OF THE IGNEOUS-METAMORPHIC COMPLEX OF SHELBURNE AND EASTERN YARMOUTH COUNTIES, NOVA SCOTIA

H. D. Rogers* and C. E. White*

INTRODUCTION

Detailed mapping of the project area, covering 3200 km^2 in southwestern Nova Scotia, began in 1983. A further season of field work will be completed in 1984. Results of the mapping, combined with petrologic studies emphasizing the granitoid rocks, will form the basis of a M.Sc. thesis by Mr. Rogers. C. E. White, field assistant during 1983, will produce a B.Sc. (Honours) thesis on metamorphic aspects of the Jordan River Area.

Although outcrop is best in coastal sections, adequate outcrop also occurs in most inland areas. Access to these inland areas has improved considerably during the last twenty-five years, due largely to an increase in logging activity and recreational use.

METASEDIMENTARY ROCKS

The eastern (Jordan River) and western (Pubnico Peninsula) limits of the map area are defined by synclines containing highly aluminous pelitic granofels and schists which have long been known for their high concentrations of andalusite, cordierite, and staurolite porphyroblasts. This lithology in the western syncline has been mapped as far north as Great Barren Lake.

The remaining metasedimentary rocks contained between the bounding synclines can be broadly subdivided into two groups: 1) a southern group consisting of mostly massive psammitic rocks containing minor interbedded, porphyroblastic, andalusite-biotite schists, and; 2) a northern group consisting almost exclusively of porphyroblastic andalusite schist containing minor metagreywacke. The latter unit extends to the northeast beyond the southern margin of Bald Mountain.

Extensive areas of migmatite are associated with the Barrington Passage pluton (Taylor, 1967). They are more extensive on its eastern margin whereas stillimanite schists and granofels predominate along its western borders.

GRANITOID ROCKS

The Barrington Passage pluton occupies much of the western part of the map area and is the largest pluton in the area. The granitoid rocks described by Taylor (1967) north of Great Pubnico Lake are petrologically similar to the main body of the Barrington Passage pluton and are included with it. The pluton consists of strongly foliated, equigranular, biotite tonalite of homogeneous composition. A septum of metasedimentary rocks 2 km wide separates it from the Shelburne pluton (Taylor, 1967) to the east.

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The Shelburne pluton has been described by Taylor (1967) as consisting of granodiorite whereas Clarke and Muecke (1980) described it as trondjemite. Preliminary results indicate a multi-phase composition with much of the western portion being granite. Like the Barrington Passage pluton, it is foliated and equigranular; however, it differs from the Barrington Passage pluton in containing both muscovite and biotite.

The presence of a large pluton in the Bald Mountain area has been confirmed by the mapping of nine new outcrops. It is outwardly similar to the Shelburne pluton, and preliminary geochemical results indicate granite composition.

Small mafic intursions outcrop in the area at Murray Cove and Birchtown, and two new outcrops of the Shelburne Dike have been found.

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GEOCHEMICAL INVESTIGATION OF MANGANIFEROUS BEDS ASSOCIATED WITH STRATABOUND LEAD-ZINC MINERALIZATION IN THE MEGUMA GROUP

M. Zentilli* and I. MacInnis*

This is a progress report emphasizing the contribution made to our continuing research of multi-element geochemical analyses of 50 drill core samples from Eastville, Colchester County, financed by the Nova Scotia Department of Mines and Energy during the summer of 1983.

Disseminated lead-zinc mineralization was discovered and outlined in 1976 by St. Joseph Explorations Ltd. (now Sulpetro Minerals Ltd.) through drilling of soil geochemical and electromagnetic anomalies (Binney, 1977) at Gold Brook (45°16'45"N; 62°62'44"W), 2 km southeast of Eastville, Colchester County. Concentrations of up to 2 per cent and locally 7 per cent of combined lead and zinc over stratigraphic thicknesses of 1 to 14 m, occur along 10 km of the strike of the transition between the Goldenville and Halifax Formations of the Cambro-Ordovician Meguma Group (Sangster, 1978; Binney, 1979; Binney, Sangster, and Zentilli, 1983).

Mineralization is distributed mainly within a unit of locally-calcareous, finely-laminated and contorted quartz metawacke with interbedded slate at the top of the Goldenville Formation and within overlying graphitic slates of the Halifax Formation. At the base of the stratigraphic section is a massive grey unmineralized quartz wacke. The rocks have been metamorphosed to the greenschist facies, deformed into tight upright folds during the Devonian Orogeny, affected by the contact with a Devonian Acadian Orogeny, and affected by the contact with the Devonian granitoid pluton. Subsequent deformation has greatly complicated the structure of parts of the deposit.

Sulphide minerals are pyrrhotite, pyrite, spalerite and galena with minor arsenopyrite and chalcopyrite. Styles of occurrence of sulphides include (i) stratiform (ii) foliation controlled, and (iii) discordant fracture-filling (Jenner, 1982). The latter style, networks of veinlets of sphalerite and galena locally accompanied by calcite accounts for the highest grades of the deposit, and occur preferentially in more tectonically disrupted areas.

Manganese concentrations of up to 11 per cent MnO are characteristic of the mineralized strata, and this element is contained mainly in spessartine garnets (22-29% MnO), but also in carbonates, iron sulphides, and in the silicate matrix. The chemical composition of the different lithologic units, including the manganiferous "coticule" beds, has been analyzed statistically, to identify empirical groupings of elements that can be ascribed to particular mineral associations (e.g. Chave and MacKenzie, 1961), and it has been assessed in terms of stratigraphic and other parameters, and compared with similar rock units studied elsewhere. The composition of the different rock units is strongly dependent on the proportions of slate and metawacke components. Metamorphism appears to have been isochemical, and our preliminary isotopic results suggest a local source for the carbonate. The granite pluton has been a passive element in terms of mineralization, although it appears responsible for a local increase of the Zn/Pb ratio. Therefore, the deposit appears to represent the metamorphosed and locally-remobilized equivalent of a manganese-lead-zinc-rich metalliferous sediment. As such, its geochemistry suggests a diagenetic origin, but a hydrothermal contribution cannot be discounted at this stage.

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One of the interesting results is the recognition of bituminous matter in the host rocks, which contain more carbon than can be accounted for in carbonate and graphite. Carbon occupies oriented inclusions in spessartine, pore space in lensoid units, crenulation cleavage, and fossil chitinozoa (P. E. Schenk and D. B. Brett, work in progress). The carbonate may not be an original component of the flysch-like sediments, believed to be deposited below the CCD; among the preferred phyotheses is that which would have the carbonate be a result of oxidation of the organic matter in the sediments (MacInnis 1983; and work in progress).

The Goldenville-Halifax transition emerges as an important control for mineralization in Nova Scotia. In addition to lead-zinc at Eastville, our studies have documented the concentration at that level of tungsten-zinc associated with conticule beds at Lazy Head (Shaw, 1983); and it is well-known that gold deposits in the Meguma Group favour a slate- to-metawacke ratio of unity (e. g. Graves and Zentilli, 1983), which has been used to define the Goldenville-Halifax transition (Schenk, 1970). Perhaps over 90% of the metallic mineralization hosted in Meguma Group rocks is controlled by this transition.

Manganiferous beds are good guides to mineralization in a variety of metamorphosed stratabound base metal deposits (Stanton, 1976; Stumpfl, 1979). In addition, Kennan and Kennedy (1983) have emphasized the potential value of manganiferous sediments such as coticules, as tools in long-range stratigraphic correlation within the Caledonian Appalachian orogen.

Acknowledgements: Sulpetro Minerals Limited provided drillcore and detailed information. Funding has been provided by National Science Engineering Research Centre operating grant A-9036 and the Nova Scotia Department of Mines and Energy.

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POLYGENETIC ORIGIN OF GOLD DEPOSITS, EASTERN MEGUMA TERRANE

S. J. Haynes

The gold deposits of the eastern Meguma Terrane are hosted by turbidite sequences of the Goldenville Formation. Regional metamorphism ranges from chlorite grade in the south to staurolite-andalusite grade in the north (Fig. 1).

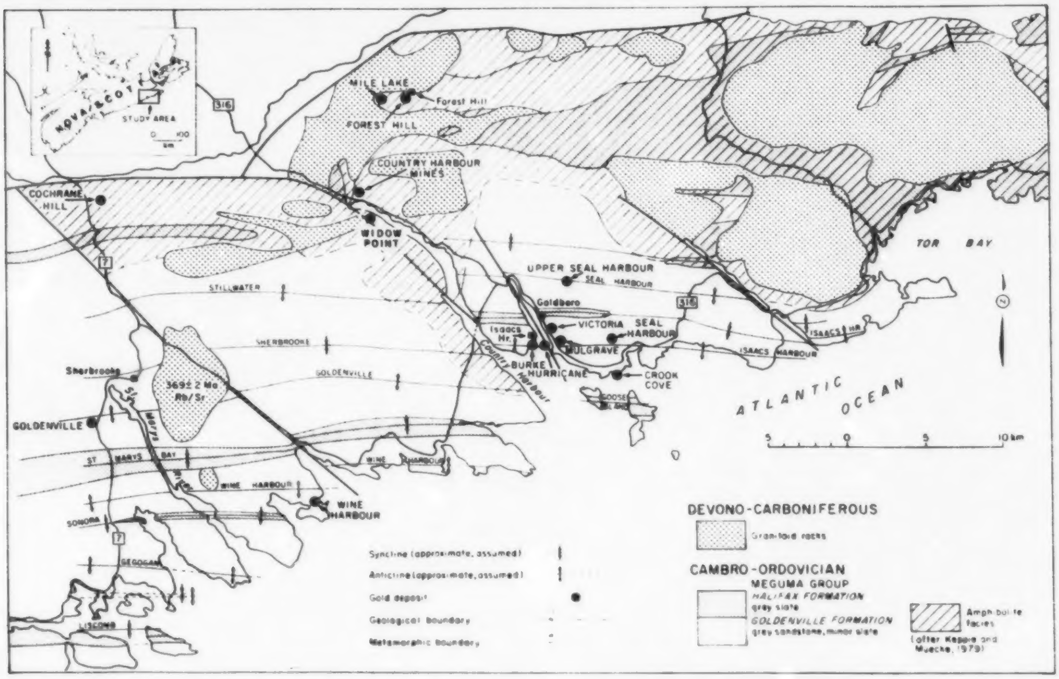

Figure 1. Location of gold deposits and geology of the eastern Meguma Terrane.

In the greenschist facies, gold is present in both host rock metalliferous slates and early vein types predating granitoid intrusion and Acadian deformations and metamorphism (Fig. 2). The presence of mesoscopic monoclines and monoclinal flexures (Keppie, 1983; O'Brien, 1983) on the flanks of Acadian folds in several gold districts suggests these flexures may represent tectonic activation of early fault zones (Haynes, 1983). Solution channelways along such faults may be represented by crosscutting quartz + K-feldspar ± muscovite step veins that assumed their present shape during Acadian flexural-slip folding. Both step veins and stratabound veins (hydrothermal sills) exhibit marked arsenopyrite-sericite wall rock alteration. Gold is enriched where step veins meld with stratiform quartz veins. These stratiform veins are the main gold producers. They exhibit crosslamination and columnar structures, similar to modern geyserites at Yellowstone, and are usually rich in carbonate.

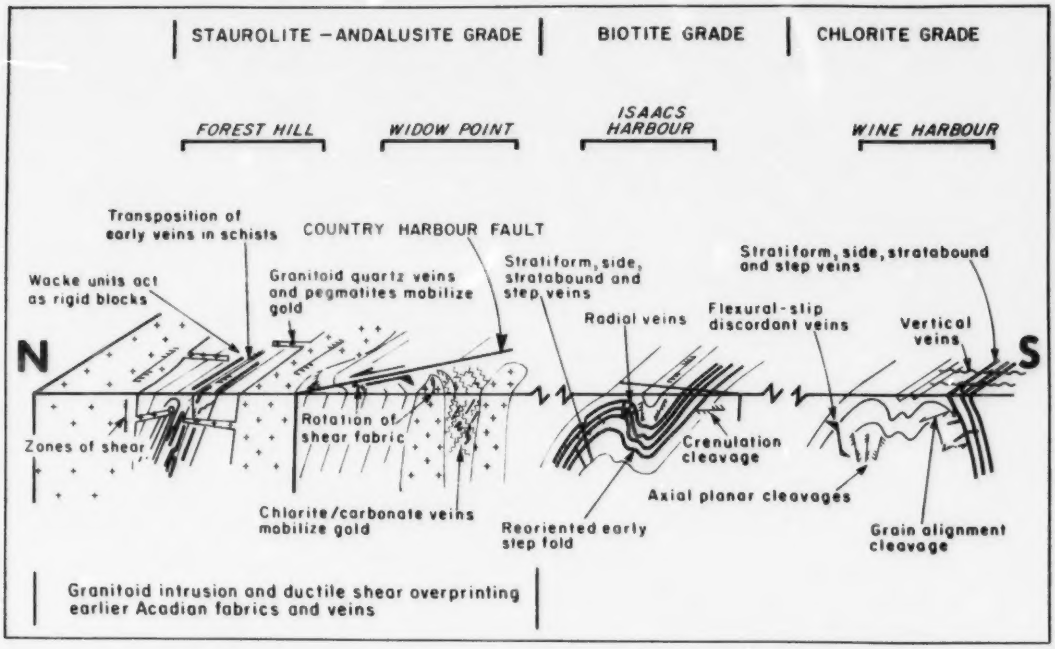
STAUROLITE – ANDALUSITE GRADE
BIOTITE GRADE
CHLORITE GRADE
FOREST HILL
WIDOW POINT
ISAACS HARBOUR
WINE HARBOUR
Transposition of early veins in schists
COUNTRY HARBOUR FAULT
Wacke units act as rigid blocks
Granitoid quartz veins and pegmatites mobilize gold
Stratiform, side, stratabound and step veins
Stratiform, side, stratabound and step veins
Radial veins
Flexural-slip discordant veins
Vertical veins
N
S
Zones of shear
Rotation of shear fabric
Crenulation cleavage
Axial planar cleavages
Chlorite/carbonate veins mobilize gold
Reoriented early step fold
Grain alignment cleavage
Granitoid intrusion and ductile shear overprinting earlier Acadian fabrics and veins

Figure 2. General north-south geological section showing relation of gold deposits to regional metamorphism and structure, granitoid intrusion and late movement on the County Harbour Fault.

Chemical analysis of an auriferous stratiform vein and wall rocks at the Mulgrave shaft, Goldboro, reveals a direct logarithmic relationship of Au, Ag, Hg, and, to a lesser degree Sb. In the quartz vein these elements are also directly related to As and S, but in the host rocks the distribution of As and S is a function of Fe as pyrite or pyrrhotite which appears unrelated to Au. These relations are consistent with an epigenetic origin for the veins.

Arsenopyrite, gold, and sphalerite from quartz veins in the greenschist facies were analyzed by electron microprobe. Arsenopyrites are commonly zoned with most values between 32 and 34 atomic per cent As, all less than 35 atomic per cent As. Although pyrite was observed in the same polished sections as arsenopyrite-pyrrhotite intergrowths, no three-phase mutual grain boundaries were observed, so Kretschmar and Scott's (1976) arsenopyrite geothermometer cannot be used without determination of sulphur fugacity. Application of the electrum tarnish curves of Barton and Toulmin (1964) to the gold analyses reveals that the compositions (less than 12 atomic per cent Ag) correspond to sulphur fugacities well above the arsenopyrite stability field. Because no argentite was observed, the true sulphur fugacity could not be determined, therefore the arsenopyrite temperatures lie somewhere below 550°C. Thirteen sphalerites, co-existing with pyrrhotite and pyrite, taken from a 0.5 m length of stratiform vein at Isaacs Harbour have compositions between 9 and 15 mole per cent FeS. This can be interpreted as follows: 1.) the pressure during successive metamorphisms varied between $4.5x10^5$ and $1x10^6$ kPa (4.5 to 10 Kb; geobarometer of Scott, 1976; Lusk and Ford, 1978); 2.) the equilibration temperatures were below 300°C (geothermometer of Scott and Kissin, 1973); or 3.) equilibrium was not attained. The pressures are unreasonable because the metamorphism is low-pressure Pyrenean (Keppie and Muecke, 1979) with andalusite not kyanite at its maximum. Although nonequilibrium cannot be discounted, it is interesting to note that the compositional spread is similar to the natural assemblages at Broadlands used by Browne and Lovering (1973) to derive a natural phase diagram. Application of this to the Meguma sphalerites yields temperatures of 260 ± 10°C identical to temperatures obtained from fluid inclusion homogenization studies of this vein (Yonover et al., in preparation). Most veins in the greenschist facies have homogenization temperatures of 265 ± 5°C and low salinities (5 to 8 weight per cent NaCl). Capacitance manometer determinations, following laser decrepitation extraction, revealed high CO_2, with the highest values in stratiform veins (mCO_2 up to 1.6) and lower values in step veins (mCO_2 0.2 to 1.2). These values, and the differing mineralogies of the step and stratiform veins are similar to the auriferous hot spring systems at Broadlands, New Zealand (Ellis, 1979). There, boiling off of CO_2 from low salinity, relatively high CO_2 ($mCO_2 = 0.15$) solutions yields quartz + K-feldspar + K-mica ± carbonate assemblages in the vent (Meguma step veins) and a CO_2-rich discharge. In the Meguma Terrane this discharge was submarine and formed a low-density buoyant plume, from which precipitated the quartz + carbonate + mica (clay) stratiform veins and auriferous slates.

In the northern sector of the eastern Meguma Terrane (Fig. 2), granitoid intrusions and associated pegmatites and quartz veins have cut and tourmalinized Acadian pressure solution cleavages and at Forest Hill mobilized gold. At about the same time, static regional metamorphism overprinted the earlier veins. Subsequently, zones of dextral ductile shear transposed the different earlier veins to bedding-parallel orientations in belts of schist but, preserved many structures in the metawackes, which acted as semirigid blocks. The amphibolite facies quartz veins exhibit trimodal fluid inclusion homogenization temperatures of 260°C, 335°C and >350°C, and an overall decrease of mCO_2 values. Presumably, this is a reflection of the additional effects of metamorphism, intrusion and shear.

The last tectonic event was brittle deformation related to left-lateral movement on the Country Harbour Fault. At Widow Point (Fig. 2) this is associated with chlorite-carbonate veins and breccia fillings that have locally retrograded the schists and mobilized gold.

Preliminary lead isotope analyses of quartz vein galenas (Farquhar and Haynes, in press) indicate that the least radiogenic data points lie close to the average terrestrial growth curves and define the mean model age 550 Ma.

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SOME OBSERVATIONS AROUND THE COCHRANE HILL GOLD DEPOSIT, GUYSBOROUGH COUNTY, NOVA SCOTIA

P. K. Smith

The Cochrane Hill gold district lies within regional amphibolite grade metasedimentary rocks of the Goldenville Formation. This gold deposit is located on the overturned south limb of the isoclinal Cochrane Hill Anticline approximately 200 m south of the axial trace. Rarely observed minor folds show an open to tight shape and plunge gently to moderately westward. The symmetry of these minor folds is a good indicator for locating major fold axis. However, folded quartz veins with variable plunge angles and directions frequently show incorrect symmetry to the major fold.

Gold mineralization at Cochrane Hill is associated with at least six different types of quartz-bearing veins during four generations of gold mobilization (Smith, 1983a). Visible gold occurs not only within the veins, but also in the host metasedimentary wall rocks. Petrographic investigation also reveals the presence of significant amounts of gold around and within sulphide and silicate minerals. Analysis of gold from this deposit indicates silver values ranging from approximately 2.5 to 9.5 per cent and show a bimodal distribution supporting at least two periods of associated gold crystallization.

The Cochrane Hill deposit and the Crow's Nest deposit further west are enclosed within discontinuous lens-shaped alteration zones defined by the presence of arsenopyrite in association with galena, sphalerite, and chalcopyrite, plus silicification zones throughout some of the walls rocks. Arsenopyrite and tourmaline alteration are common along many vein margins although tourmaline is also found in association with some late stage veins outside the halo. Chlorite, carbonate, and sericitic alteration is associated with the zones of silicic alteration . Thin zones of biotite and garnet are common along the margin of many veins, probably representing chemically altered halos prior to amphibolite grade regional metamorphism.

Profile sampling across the open-pit at Cochrane Hill (Smith, 1983b) indicates that there are economic quantities of gold both in the quartz veins and within the wall rock metasediments and alteration zones around the veins. Although it appears that wherever arsenopyrite is present gold is found, a comparison of gold versus arsenic at Cochrane Hill shows half the samples with a direct correlation and half with an inverse correlation. Correlation of gold with most trace elements is not apparent from the prelimary examination of samples analysised thus far. Analysis of arsenopyrite shows a variation of 31.5 to 40.0 atomic per cent arsenic. The presence of loellingite in one of these samples suggests equilibration temperatures of between 550° and 610°C. This is consistant with peak regional metamorphic conditions during the Acadian Orogeny. This sample is from an early vein that has undergone the recrystallization effects during the regional metamorphism. Veins post-dating the metamorphism may show a lower termperature of formation which is more indicative of the ore forming solutions.

Examination of quartz veins outside the Cochrane Hill gold district reveals a distinctly different mineralogy than those within the auriferous district. They are characterized by a higher quartz content with minor alkali-feldspar and muscovite. Occasionally garnet, staurolite, and andalusite are also present. These lack the sulphide found in the veins within the gold district. Stratabound veins are also not as prominant, while crosscutting and en-echelon tension gashes are more common. Locally however, strataform veins outside the Cochrane Hill gold district have a mixed mineralogy that more closely represents veins observed around the mine area. Pyrite and pyrrhotite are the only sulphides observed. One such vein containing thin zones of calcite, garnet, and sugary quartz is exposed on the West Side of St. Mary's River Road, 100 m south of the Cochrane Hill Anticline. Similar veins have also been observed elsewhere in gold districts having rocks with amphibolite metamorphic grade.

The geometry of the Cochrane Hill anticline exposed west of the open-pit and on West Side St. Mary's River Road is isoclinal with the south limb slightly overturned. Parasitic folds are common near the hinge zone.

Two small intrusions are exposed along the West River St. Marys Fault. They probably have different geological ages. A strongly deformed, dark blue-grey, muscovite-biotite granite with augen texture, lies adjacent to and on the south side of the fault. It is located approximately 4 km west of Cochrane Hill. The intrusion probably has a Devonian age, which is typical of the granitic plutons in this area.

On the north side of the fault, approximately 1 km north of Cochrane Hill, is an amphibole-bearing diorite containing volcanic inclusions. The best exposures occur along the Nine Mile Woods Road. Although this intrusion has been deformed by shear movement along the fault, it is less deformed than the augen granite further west. The age of this diorite is possibly Carboniferous. It may be equivalent to the age of the Fisset Brook Formation exposed 15 km to the northeast.

Both these intrusion may have influenced the alteration and associated mineralization around Cochrane Hill.

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TILL STRATIGRAPHY AND GEOCHEMISTRY, FOREST HILL GOLD DISTRICT, NOVA SCOTIA

I. J. MacEachern, R. R. Stea, P. J. Rogers

INTRODUCTION

During the summer and fall of 1982, an extensive trenching program was conducted at the Forest Hill gold district by Seabright Resources Incoporated. The study exposed several km of excellent 2 to 3 m thick till profiles in nine trenches oriented perpendicular to the strike of both the veins and host strata of the deposit. This afforded the authors a unique opportunity to study the till stratigraphy, and the 3-dimensional dispersal of gold and related elements from a bedrock source by glacial and post glacial processes.

The project is part of the Canada-Nova Scotia Co-operative Mineral Program 1981-1984. When completed, it will consist of an integrated geochemical survey of bedrock, till, and soil aimed at developing effective geochemical techniques for locating new gold deposits and re-evaluating old gold deposits in the rocks of the Meguma Group.

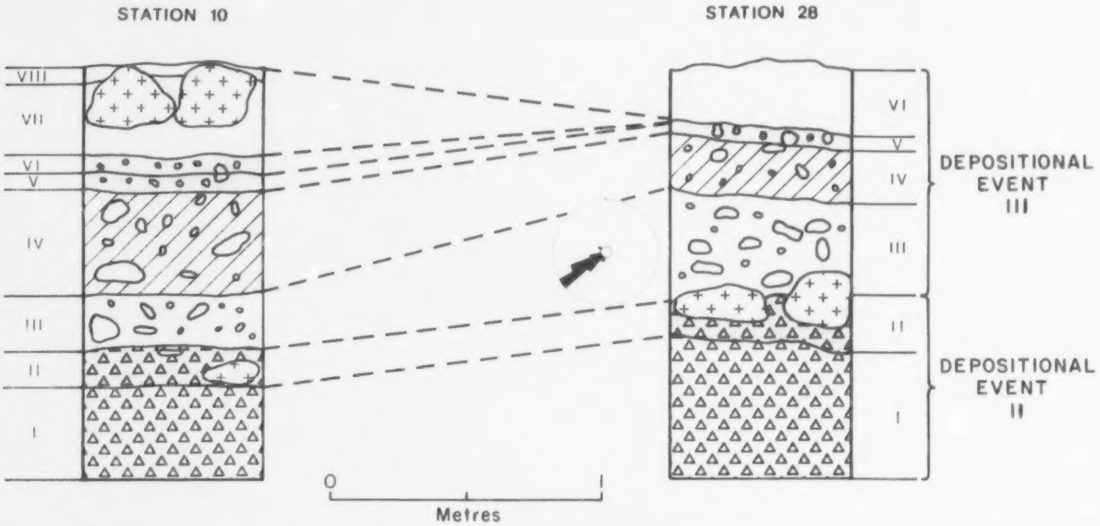
Sampling was conducted at 25 m intervals along the trenches. At each sample site the till stratigraphy was described, and the section was systematically profile-sampled at metre intervals. In addition, each till unit was panned to obtain a heavy concentrate for analysis. The coarse pebble fraction was removed during the panning process using a gold pan sifter, and the pebbles were counted and grouped into principal lithologies. At every fifth site, till fabric measurements were obtained from each sample unit. Till fabrics, pebble counts and measurements of bedrock and boulder pavement striations were used to reconstruct former glacier movements at the Forest Hill area.

REGIONAL PLEISTOCENE GEOLOGY

In the eastern Meguma Terrane bedrock striations and roche mountonnées indicate a major period of southeastward ice flow (140°-160°). A till sheet associated with the major southeastward flow has been recognized in the area (Stea and Fowler, 1979). It is a loose, sandy till which displays rapid transitions in lithological facies, southeastward across bedrock contact zones. In some areas an extensive melt-out phase has developed forming hummocky topography. A regionally consistant striation set trending 180° crosscuts the southeastward trending striations. Pebbles of Silurian fossiliferous sandstones and volcanic rocks along the Eastern Shore and the southwest trending eskers (Stea and Fowler, 1979) attest to the ice flow that crossed or stemmed from the Antigonish Highlands.

TILL STRATIGRAPHY AT FOREST HILL

The surficial deposits of the mine area indicate three major depositional events. The earliest episode is represented by a lightly cemented and oxidized gravel which is observed most commonly in areas of topographic depression. This is overlain by two till units interpreted as lodgement and/or ablation phases of deposition. The older unit is an olive-brown semi-compact till which was emplaced by a southeastward ice flow. The youngest unit is a yellowish brown, loose, sandy till which was formed by a west-southwest ice flow. Figure 1 illustrates a correlation of two trench sections from Forest Hill showing the upper till units and inferred depositional events.



VIII - Humus layer (L)

VII - Leached soil layer (Ae)

VI - Dark brown cemented soil (Bhf)

V - Dark orange brown soil (Bf)

IV - Orangy-yellow layer of altered till

III - Bleached till, coarse sand matrix

II - Yellowish-brown layer (paleosol?) fine sand/silt matrix

I - Olive-brown till, fine sand/silt matrix compact

VI - Slumped material

V - Orange-brown soil (Bhf)

IV - Altered till, orange-yellow colour

III - Greenish-brown till, coarse sand matrix very loose, unconsolidated

II. Yellowish-brown layer, fine sand/silt matrix (paleosol?)

I - Olive-brown till, medium sand matrix compact

Figure 1. Till stratigraphy at Forest Hill. Stations 10 and 28 show depositonal events two and three.

Frequently, these upper two units are separated by a widespread 10-15 cm dark yellowish-brown zone tentatively interpreted to be a paleosol. This interpretation implies that the two depositional events were separated by a period of climatic amelioration and ice retreat. The dark yellowish-brown color appears to coat the grains, and there are many small rootlets within the unit. In addition, the results of chemical and grain size analyses performed at the soil science laboratories of the Nova Scotia Agricultural College support this assertion.

Pollen studies to be conducted on several of the till sections should help clarify the paleosol question.

GOLD DISTRIBUTION

Figure 2 depicts the sample sites, glacial features, and panning results of the survey. Results from the systematic panning of the till units have shown that where gold is present, it is usually confined to the unit closest to bedrock in areas of high bedrock topography, and is

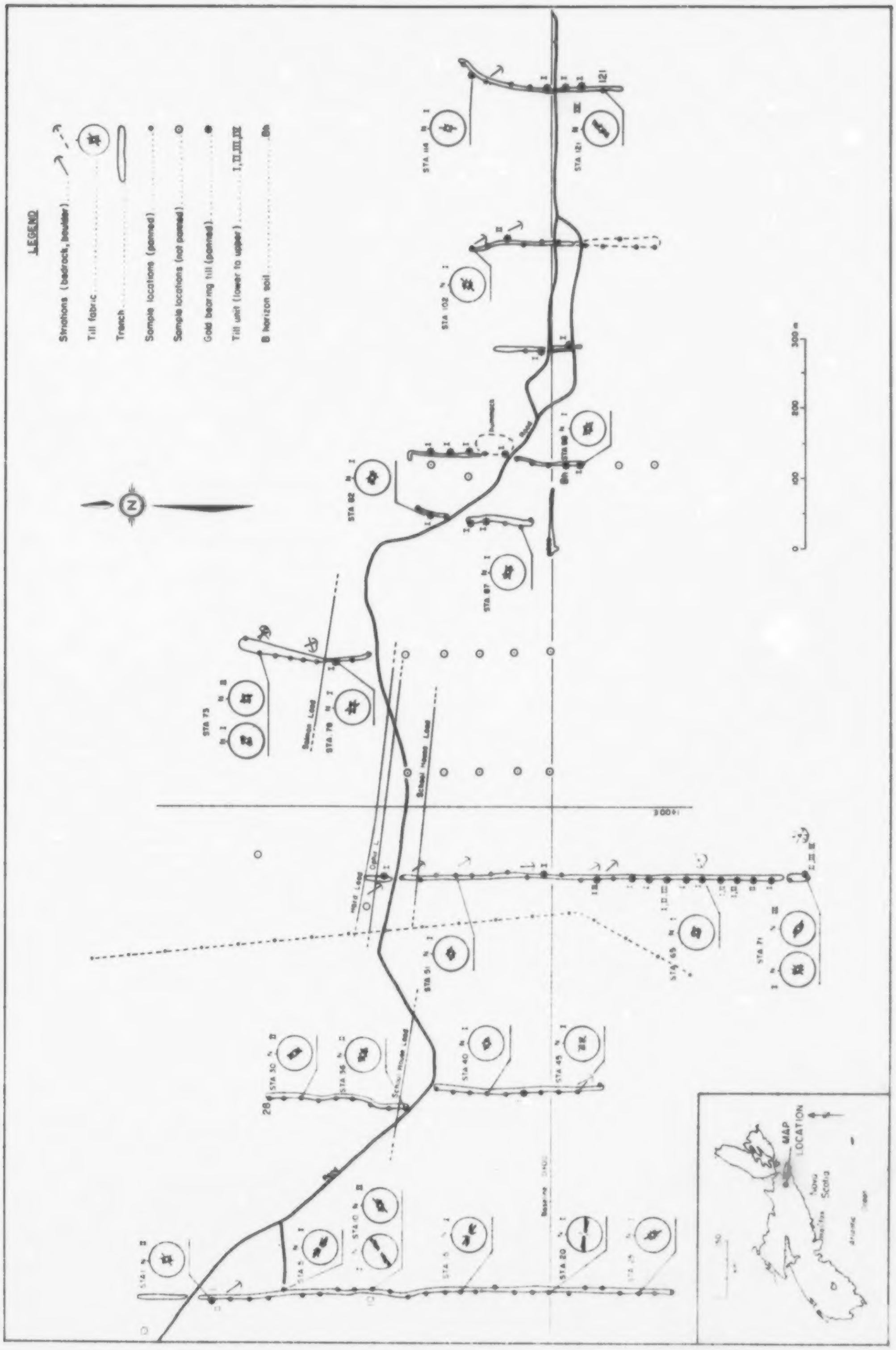
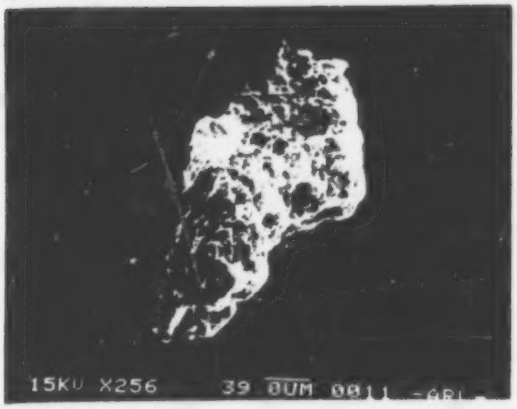
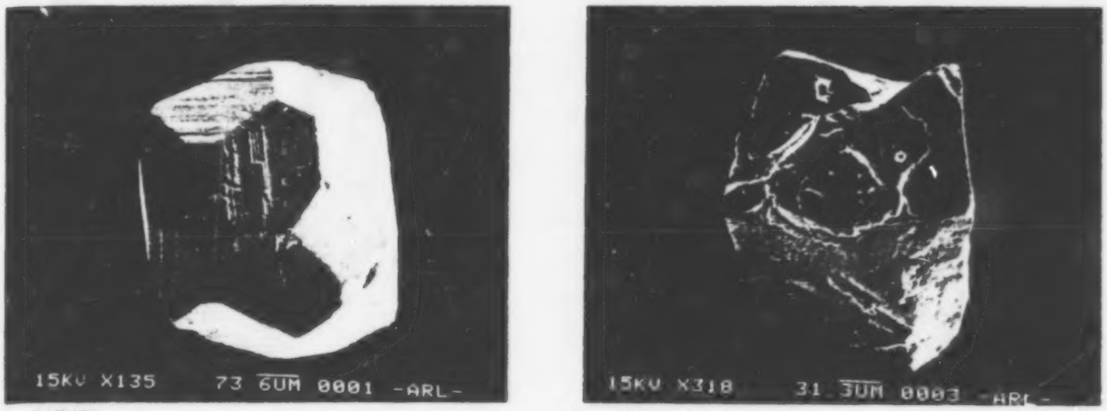


Figure 2. Area map illustrating sample sites, trenches, ice movement indicators and gold distribution at Forest Hill.



A GOLD

B GOLD



C GARNET

D ILMENITE

Figure 3(A). Example of a gold nugget.

(B). Example of a gold flake. Note slender, delicate extensions at grain edge indicating mineral deformation during transport.

(C). Euhedral garnet crystal. Note the sharp contact between crystal faces indicating minimal abrasion during transport.

(D). Example of an ilmonite grain.

generally found in most units, including soils, in areas of topographic depression.

The lateral distribution of gold in the till generally parallels the ice flow direction from known leads, illustrating the mechanical dispersal of gold. There are, however, several areas of rich till which cannot be explained in this way. These may be indicative of post glacial dispersal processes or mechanical dispersal from undiscovered auriferous leads.

Our understanding of the gold distribution in till at Forest Hill will be greatly supplemented pending the results of the geochemistry survey which includes analyses for Au, Ag, Cu, Pb, Zn, Sb, and Hg.

CHARACTER OF THE GOLD

The gold in the till is present as both small flakes and small nuggets. Examination of grains with a scanning electron microscope shows the grain surfaces to be characteristically rough and pitted and exhibiting little evidence of deformation indicative of abrasive transport. This is also true of the other minerals which comprise the heavy mineral suite.

Photomicrographs of minerals recovered from the panned heavy concentrate are shown in Figure 3. The magnification and bar scales are shown on the individual photos.

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DEVONO-CARBONIFEROUS MAGMATISM AND EPITHERMAL U-TH-MO>AG->F MINERALIZATION IN THE DEBERT LAKE AREA, EASTERN COBEQUID HIGHLANDS

G.S.C. Project No: 830032

A. K. Chatterjee

Anorogenic bimodal volcanic rocks of Devono-Carboniferous age are widely distributed in parts of Cape Breton (Fisset Brook Formation), Antigonish Highlands (McAras Brook Formation), and Cobequid Highlands (Bayers Brook Formation). Published literature by various authors suggest that the volcanism was related to extension tectonism, that basaltic magma was derived from the mantle, and that the rhyolites were derived from the partial melt of the crustal rocks. However, the environment for ore deposition in these rocks is poorly understood. The present investigation was undertaken to investigate the metallogenic evolution of the Bayers Brook Formation.

The Bayers Brook Formation in the Eastern Cobequid Highlands has been mapped over most of its aerial extent (Donohoe and Wallace, 1982) and was explored extensively by Gulf Minerals during the year 1977-81. The present work is based exclusively on the diamond drill core from an area which measures approximately 5 km x 1 km, termed the Debert Lake area.

In the eastern half of the Debert Lake area, the Bayers Brook Formation is represented in stratigraphic order by: three ignimbrite sheets capped by rhyolitic lavas, five basaltic flows, a chert-siltstone, sequence unconformably overlain by basaltic and rhyolitic flows. The above volcanic pile is intruded by a large number of dykes and sills (averaging 3.85 dykes per drillhole) and a few of these may be the feeder dykes. The entire sequence is approximately 1670 m thick, strikes east-west and dips steeply towards north. In the western half of the area, the Bayers Brook Formation (Z1100 m thick) is represented by a sequence of polymictic upward fining conglomerate, six basaltic flows, four rhyolite flows, and a large number of dykes and sills which range in width from less than 1 m to over 60 m. Within this sequence, anorthosite dykes are common. This is the first documentation of anorthositic rocks in the paleozoic volcanic sequences of the Avalon Zone.

The entire sequence in the Debert Lake area is intruded by the granitoid rocks of Hart-Lake Bayers Lake pluton and rhyolite stocks (domes ?) which are in turn intruded by porphyritic diabase dykes.

The epithermal U-Th-Mo>Ag->F mineralization occurs in high level intrusive stockworks, and collapse breccias both in the rhyolite dome and fractured volcanic and volcaniclastic rocks. The mineralization occurs exclusively in zones which have witnessed intense alkali metasomatism. The metasomatized rocks are characteristically in the 61-67% SiO_2 range, thus partially filling the "Daly gap". The fluorine-rich alkali basalts contain cassiterite and may by potential economic hosts for volcanogenic tin mineralization. The Na-rich hornblende granite (containing >5% normative acmite) may be a potential host for Zr, Y and possibly Nb and Ta.

In summary, it is postulated that: the volcanism was tiggered by magma mixing; the volcanic rocks represent a zoned magma chamber, and; the epithermal mineralization was related to late stage magmatic activity represented by intrusive rhyolite dome(s). The alkali metasomatism in rocks is a diagnostic guide to mineralization.

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EDUCATION AND PUBLIC AWARENESS

Howard V. Donohoe, Jr.

Mines and Minerals Branch established The Education and Public Awareness Program in 1982 to provide non-technical information about the geology and mineral resources of the Province. Users of the information include the public, schools, and other government agencies. The benefit of such a program is an increased awareness of the geology and mineral resources of Nova Scotia. Both the Department and the exploration and mining industry will benefit by a better public image. Hopefully, the Program will also increase the number of informed people andorganizations discussing problems such as exploration and mining guidelines, land use planning, and science education.

A wide range of program activities were either started or completed this year. For the first time, the Department had a booth on the floor of the Prospectors and Developers Association Convention. The Annual Report of the Department of Mines and Energy was published in a more timely manner and with a reorganized content which followed organizational lines. A pamphlet for "Sharing the Land"--a campaign developed by Voluntary Planning--described the rights of land owners, the mineral rights, and the difference between exploration and mining. Press releases about the Branch's publications have made more people aware of the technical information we make available.

The "Prospecting and Geology in Nova Scotia" course is being offered again this year. The course is presented through the cooperation and financial assistance of the Nova Scotia Department of Mines and Energy, the Chamber of Mineral Resources of Nova Scotia, and the Department of Geology at Dalhousie University. Twenty people are enrolled in this year's class, with nearly an equal number on the waiting list. Land has already been staked as a result of the course. The Department and the Chamber of Mineral Resources are considering offering the course in other centres across the Province next year.

Two pamphlets, "Mining History of Nova Scotia", and the "Geological History of Nova Scotia", are in the manuscript stage. In addition, the Department and the Nova Scotia Museum are cooperating on informative "regional" brochures about the geology, geomorphology, and mineral resources of selected areas of the Province. The first of these brochures describes the Five Islands Park area of northern Nova Scotia. It is being developed in cooperation with the Museum, the Chamber of Mineral Resources of Nova Scotia, and the Nova Scotia Department of Lands and Forests. Several other projects underway will emphasize the importance of mineral resources, prospecting, exploration, and mining in social studies and science ciricula.

PROGRESS REPORT ON THE GEOLOGY OF THE ANTIGONISH HIGHLANDS

J. B. Murphy*

INTRODUCTION

Geological mapping in the Antigonish Highlands this summer was the continuation of a project initiated in 1978 by the Nova Scotia Department of Mines and Energy, in co-operation with the Department of Regional Economic Expansion. At that time, mapping was concentrated on the northern Antigonish Highlands. The purposes of the present study, funded by Energy, Mines, and Resources, Canada, are to map the adjoining northwestern and southern Highlands; to describe the volcanic, sedimentary and plutonic rocks and their stratigraphic and structural relations; to determine their geological history; and to examine the potential for mineralization. The total area of the Antigonish Highlands is about 1500 km^2. To date, 650 km^2 have been mapped: 300 km^2 in 1978 and 1979 (Murphy et al., 1979, 1980, 1982) and 350 km^2 this summer.

Stratigraphic and structural relationships described below, when augmented with previous work, (in collaboration with J. D. Keppie and A. J. Hynes) allow for more comprehensive view of the geological history and tectonic setting of the Highlands. Economic mineral occurrences have been, to date, of rather limited interest (Bourque, 1982); interpretation as to the economic potential has been hindered by lack of stratigraphic control. This report describes interesting new mineral occurrences in the Highlands and provides the stratigraphic and structural field relationships within which they may be investigated.

Previous Work

A memoir on the geology of the Antigonish Highlands was prepared by Benson (1974). He interpreted the strata of the Highlands as representing a folded and faulted pre-Silurian eugeosynclinal assemblage of probable Cambro-Ordovician age, overlain by less disturbed Siluro-Devonian sedimentary and volcanic rocks. However, reconnaissance work (Keppie, 1978) followed by detailed mapping (Murphy et al., 1979, 1980, 1982) indicated that much of the strata of the Antigonish Highlands is Precambrian in age. Fossiliferous Cambrian strata unconformably overlie the older rocks. Geochronological studies by Cormier (1979; personal communication, 1980) and Wanless (1967; written communication, 1980) and palaeontological studies by Landing (et al., 1979) have substantiated these interpretations.

The mapping by Murphy (et al., 1979, 1980, 1982) resulted in the abandonment of the Browns Mountain Group of Benson (1974) to which these rocks were previously considered to belong, and recommended the establishing of three new groups: The Georgeville Group, which is Precambrian in age, and the Iron Brook and the MacDonald Brook Groups, which are Cambrian in age, and related to each other by lateral facies variation. The study showed that Precambrian and Cambrian rocks have distinctly different sedimentary and structural histories. Geochemical data from the Precambrian and Cambrian volcanic rocks indicate that each group of rocks belongs to a different tectonic setting.

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The Georgeville Group was interpreted to represent a narrow deep-water basinal sequence, probably floored by oceanic crust. The group is dominated by finely laminated mudstones, greywackes, matrix-supported conglomerate, and interlayered basalts (and associated dykes) with minor cherts and limestones. These rocks were polydeformed and post-tectonically intruded by granite (alaskite) and gabbro (appinite) in the latest Precambrian. Cambrian rocks in the northern Antigonish Highlands document a further rift related succession. The Iron Brook Group consists of fluviatile to shallow water marine fossiliferous sediments (red conglomerates and slates, pink limestones, ironstones, calcareous tuffs). The MacDonald Brook Group consists of red conglomerates, mafic and felsic volcanic rocks with minor interlayered red slates and pink limestones.

Upper Ordovician Lower Silurian rocks have been described in the Kenzieville area by Maehl (1961) and Smith (1979). The regional extent of these rocks and their tectonic synificance are unknown, though Smith (1978) suggests that they may be correlatives of the rift related (Keppie et al.) Dunn Point Formation exposed at Arisaig.

Results of Present Study

The principal results of the field work this summer may be summarized as follows:

1. The Keppoch Formation, considered by Benson (1974) to comprise the lowermost formation of his Cambro-Ordovican Browns Mountain Group is Precambrian in age.

2. The Keppoch Formation is informally subdivided into members dominated by felsic, intermediate mafic volcanic rocks, and sediments.

3. Sediments are minor in abundance in the Keppoch Formation. This contrasts with the Georgeville Group in which sediments are overwhelmingly dominant.

4. Field relationships indicate that while the stratigraphy of the Keppoch Formation partially overlaps in time with that of the Georgeville Group, contacts are unconformable on a regional scale.

5. The economic potential of the Keppoch Formation, especially members associated with felsic volcanics, looks particularly encouraging. Some interesting, apparently strata-bound, gossan zones were found. Some of these gossan zones may have considerable strike length.

6. The northwestern Highlands documents a regional extension of the northern Highlands. Stratigraphic units and structural trends defined by previous work by Murphy (et al., 1982) in the north can be extended westwards.

7. The locations of Browns Mountain Fault and the Marshy Hope Fault may approximate the boundary between that part of the Antigonish Highlands floored by oceanic crust and that part floored by continental crust.

8. Upper Ordovician to Silurian rocks are far more widespread than previously considered. Their occurrences are patchy and either flank the Highlands or are located in fault bounded troughs. The stratigraphy of rocks of this age (to date, little-known in the Highlands) is presented below. They consist of red fluviatile arkosic conglomerates, red stales, felsic volcanics, and blue green fossiliferous siltstones. The stratigraphy is similar to that on the northern side of the Hollow Fault, and the sequence represents the oldest rocks that occur on either side of the Hollow Fault.

9. Plutonic rocks in the field area may be divided into three groups on the basis of field observations incorporated with geochronological data supplied by Cormier (1980) and Wanless (1962). Appinitic gabbros and granites are probably Late Precambrian in age and granites are Devono-Carboniferous in age. Some of the Late Precambrian granites may be cogenetic with felsic volcanic rocks of the Keppoch Formation.

10. Dyke rocks are generally mafic in composition and probably of variable ages. Mafic dykes are known to have intruded strata of in the Late Precambrian, Early Cambrian, Early Ordovician, Silurian, and Devono-Carboniferous age. Distinguishing between these dykes is difficult in the field and requires detailed geochemistry.

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UPPER CARBONIFEROUS STRATA OF THE EASTERN HALF OF THE TATAMAGOUCHE SYNCLINE, CUMBERLAND BASINS, NOVA SCOTIA

R. J. Ryan*

ABSTRACT

The Upper Carboniferous strata of the eastern half of the Tatamagouche syncline consist of a series of 10 to 17 fining upward cycles of conglomerates to mudstones. Regularly interbedded lacustrine(?) limestone marker beds facilitate correlation with in the upper three units. These Upper Carboniferous rocks can be divided into seven map units: the Millsville Formation, Boss Point Formation, Cumberland Coarse Facies, Pictou Group grey beds, Pictou Group lower redbeds, Pictou Group middle redbeds, and the Pictou Group upper redbeds. Proximal to the Cobequid Highlands, to the south, alluvial fans developed. Elsewhere, sand and mud were deposited along low sinuosity, anastomosing rivers.

Copper, uranium, and recently discovered lead occurrences are related almost exclusively to carbon rich channel lag sandstones. The paleocurrent data which indicates a strongly unimodal distribution trending north north east, 340°, must be incorporated into any exploration model for the Tatamagouche Syncline area in order to locate the carbon rich lags.

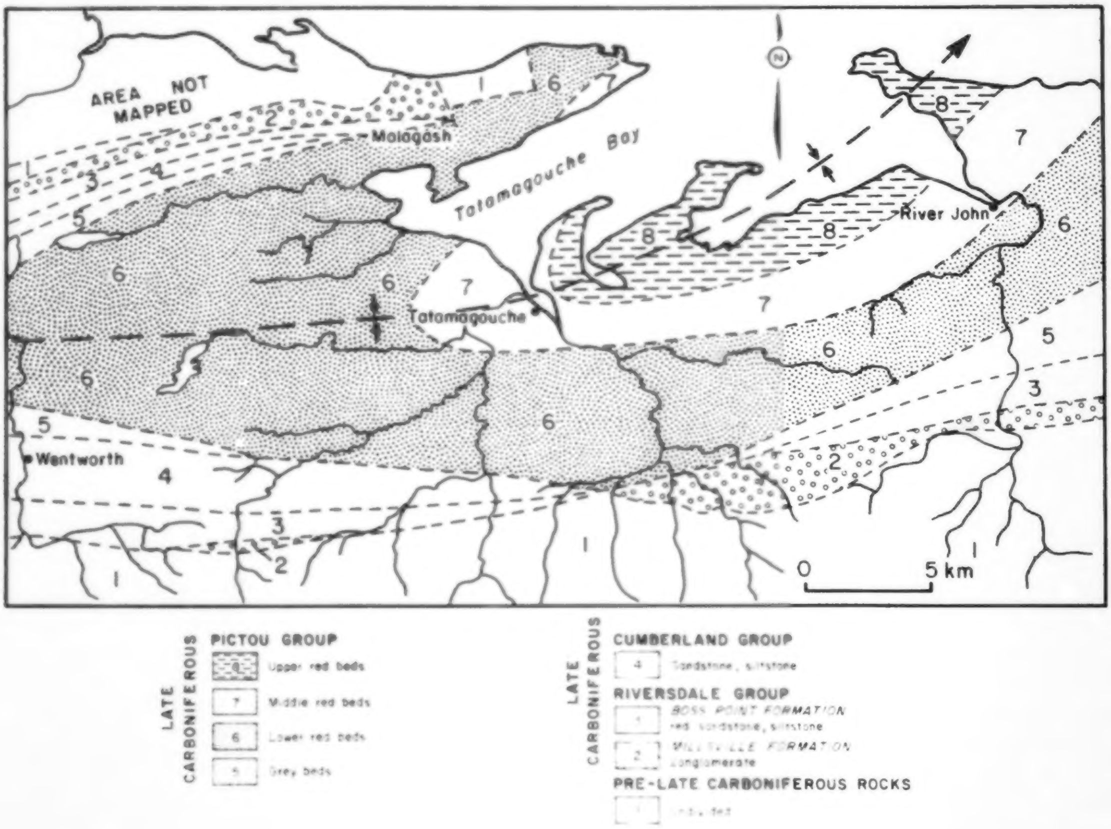

Figure 1. Geological map of the Tatamagouche area, Nova Scotia.

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OIL AND GAS EXPLORATION REVIEW

P. J. Harvey

Petroleum exploration activity off Nova Scotia has increased significantly over the past year, and plans are now underway to develop the Venture gas field 8 miles (13 km) east of Sable Island. With the Canada-Nova Scotia Agreement on Offshore Oil and Gas Resource Management and Revenue Sharing in place, this activity is expected to continue accelerating. Interest in the petroleum potential onshore has also been renewed .

OFFSHORE EXPLORATION

Nine offshore wells were completed in 1983 up to early November. Discoveries in the Sable Island area include: South Venture 0-59, Olympia A-12, Arcadia J-16 and Glenelg J-48, all of which tested new structures and all flowed significant amounts of gas. However, further drilling is required to establish their commerical viability. In addition to the wells completed, five wells were started during this period.

Of the 96 million acres (39 million ha) covered under the Canada-Nova Scotia Agreement, 39% or 37.9 million acres (15.3 million ha) are under exploration agreements to various oil companies. These exploration agreements include lands on both the shelf, where water depths reach 699 ft. (213 m), and the slope, where water depths increase up to 10,000 ft. (3048 m). Exploration on these holdings is being conducted by major oil companies (Mobil, Shell, Petro-Canada) as well as operators new to the Scotian Shelf such as Husky/Bow Valley and Home.

Development

Mobil and its partners are proceeding with planning for the development of the Venture field. Current plans call for gas to be produced from two complexes, each with five interconnected platforms. The gas will be sent by subsea pipeline to the Strait of Canso area where it will be processed and then transported to Nova Scotia and New Brunswick via an extensive new pipeline system. Exports are also anticipated to the New England States.

ONSHORE

A number of companies are operating onshore Nova Scotia. During 1983 the Department issued licences totalling 1.2 million acres (504 656 ha) to Acadia Mineral Ventures (previously MEX Exploration), Chevron, Tricentrol and Sigma. To date, 5.6 million acres (2.2 million ha) are held under provincial licence onshore Nova Scotia and in the Bay of Fundy.

During the past year, interest in the major basins of Nova Scotia increased with work programs involving mapping, seismic acquisition and sample analysis.

An onshore drilling program in the Strait of Canso area of Cape Breton got underway in early September. CORKAN Engineering of Canada Ltd., who has farmed into Sigma Resources' and M. J. Miles' et al. lands, has a drilling program approval to drill six wells.

The Department is currently working on an exploration agreement framework to be negotiated by all licence holders. In many cases these structured agreements will consolidate separate licences and more clearly outline work requirements.

STRUCTURAL HOLES IN THE PICTOU COALFIELD

K. S. Gillis

Investigations in the Pictou coalfield consisted of two holes drilled on the northern boundary of the coalfield (Fig. 1).

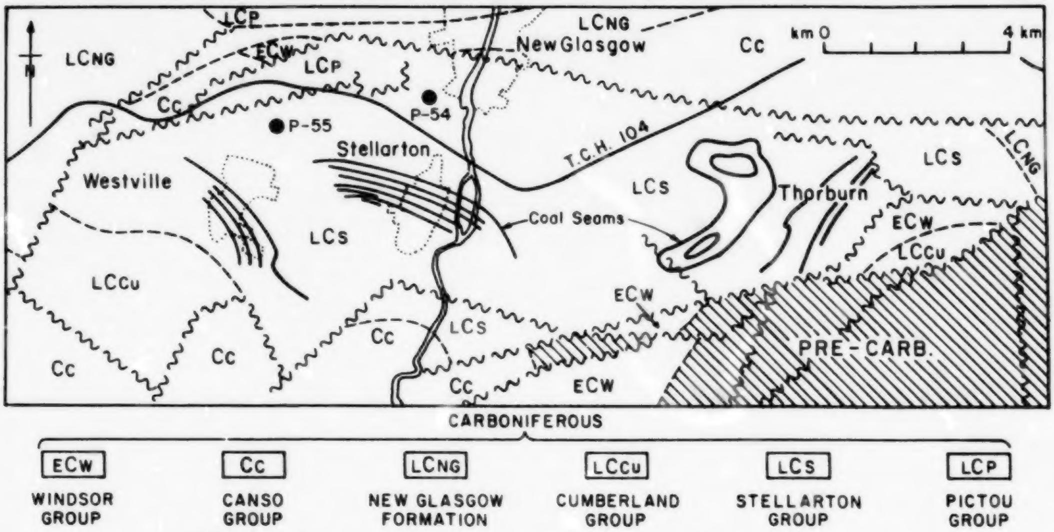

Figure 1. Geology of the Pictou Coalfield.

The holes were located to investigate the structure in the vicinity of the large faults that mark the northern end of the coalfield and to determine whether the Westville coal seams were located on the northern flank of the basin.

The holes designated P-54 and P-55 were drilled to a depth of 1017 m and 490 m respectively.

In hole P-54, the Stellarton coal seams were intersected in the top 450 m. Fossil bivalves were identified as *Anthroconauta* and as being Westphalian in age. A freshwater, lacustrine environment with moderate to high current activity was indicated.

A fault zone was encountered between 450 m and 500 m. Underlying the fault zone was a grey sandstone member extending from 540 m to 720 m. A zone of approximately 14 m within the sandstone member contained oil. Core analyses indicated a fair to poor porosity and very poor permeability.

Below 750 m redbeds were encountered to the bottom of the hole that in places contained salt. Water analyses indicated high concentrations of sodium and chloride.

Samples from the lower portion of this hole have been sent for age determination by spore analyses.

Hole P-55 was drilled near Westville. This hole intersected the Stellarton coal horizons in the top 250 m. At 350 m a fault zone was intersected that continued to 470 m. From 470 m to 490 m a medium pebble subangular to subrounded conglomerate was intersected. The hole had to be abandoned at this point due to adverse ground conditions.

COAL STUDIES IN CAPE BRETON - 1983

D. J. MacNeil

During 1983, the inventory and evaluation of near surface coal resources in the Sydney coalfield continued. A detailed report on the Tracy seam at Broughton was completed based on the previous year's drilling. Late in the year, a drill program dedicated to making final the inventory of thin seams of the upper *Linopteris oblique* zone of the Morien Group in the Donkin area was begun.

A reconsideration of the geology of the Richmond basin was begun. Several minor coal occurrences in the Riversdale Group have been exploited in the past. Though of limited extent and complex structure, these showings may suggest other areas in the basin where coal may occur in a less disturbed environment.

A coal occurrence in small isolated basin of Mabou Formation rocks (the Maple Creek Syncline) east of Glendale, Inverness County, was investigated. Stratigraphic testing of this occurrence is proposed.

In cooperation with personnel of the Cape Breton Coal Research Laboratory of EMR, the feasibility of applying geostatistical techniques to coal reserves in the Sydney coalfield is being evaluated. A test case has been prepared and further applications are being investigated.

GEOLOGICAL INVESTIGATIONS AND DEPOSITIONAL STUDIES WITHIN THE SPRINGHILL COALFIELD

J. H. Calder

INTRODUCTION

In 1983 geological evaluation of the coal resources in the Springhill coalfield continued as the natural progression of an ongoing program initiated in 1975. Investigations conducted fall into two broad categories, these being: (a) diamond drilling programs; and (b) depositional studies. The two are of course intimately related with much information on the depositional environment supplied by diamond drilling.

DIAMOND DRILLING PROJECTS

Five diamond drilling projects were undertaken during the past year from May to October under the supervision of R. Naylor and J. Calder:

(1) diamond drilling of the No. 3 seam crown pillar with a view to a potential open-pit site;

(2) split-tube drilling of the Springhill coal waste bank overlying the No. 3 seam crown pillar;

(3) diamond drilling of the No. 3 seam (upper leaf) at the Novaco open-pit mine site;

(4) diamond drilling of a strata control test hole immediately down-dip from the Novaco Rodney seam open-pit mine to be evaluated by the Strata Control Group of the Cape Breton Coal Research Laboratory; and

(5) investigation of the Nos. 7 and 6 seams north of previous mining.

The results of these programs will be discussed further in forthcoming Report of Activities.

DEPOSITIONAL STUDIES

Detailed correlations of coal seam stratigraphy and insight gained into the perhaps grosser aspects of the statigraphy of the Springhill coalfield through extensive diamond drilling programs since 1977 form the foundation of depositional studies currently being conducted by the writer through graduate studies at Dalhousie University under the direction of M. R. Gibling. The following is a partial list of facies types found within the coalfield, together with possible subenvironments. The facies types by themselves would not in all cases reveal a specific subenvironment, however with the aid of a detailed framework of coal stratigraphy deductions regarding these environments are usually enhanced.

	FACIES TYPE	**SUGGESTED SUBENVIRONMENT**
(a)	clast-to-matrix-supported pebble and cobble extraformational conglomerate	EAF, DB
(b)	grey poorly sorted feldspathic conglomeratic sandstones commonly interbedded with indurated siltstones	EAF
(c)	rare grey coarsening upward well to moderately sorted fine to coarse grained sandstones (commonly immature)	LD
(d)	grey indurated rhythmically laminated siltstone	LD/IB
(e)	grey bivalve-bearing arenaceous limestone	LS
(f)	pale grey well sorted trough cross-bedded fine to coarse grained sandstone with common mud clasts and abandoned mud filled channels	MF
(g)	pale grey moderately sorted feldspathic granule conglomerate to conglomeratic-sandstone channel scours with common mud and siderite clasts.	MF, EAF
(h)	pale grey well sorted fine grained sandstone with well developed climbing ripples	MF
(i)	parallel thinly interbedded pale grey fine grained sandstone and dark grey mudrocks	MF
(j)	thin intermediate to bright black vitrainous "rider" coal seams (<0.30 m)	VL
(k)	dark grey mudstone with tan rhizoconcretionary siderite nodules	AFP
(l)	*Stigmarian*-rooted seatearths of varying grain size (mud to sand)	VL, AFP
(m)	thick intermediate to bright black normal banded clarain-rich coal seams	AFP
(n)	dark grey mudstone with horizontal laminar to lenticular siderite	AFP
(o)	thin discontinuous cone-in-cone argillaceous limestone	AFP
(p)	mottled red-brown and green-grey mudstone	SAFP
(q)	red-brown mudstone (massive)	SAFP

KEY

EAF	ephemeral alluvial fan-fluvial
DB	distal braidplain
LD	lacustrine delta
IB	interdistributary bay
LS	lacustrine shoreline
MF	meandering fluvial
VL	vegetated levee
AFP	alluvial flood plain
SAFP	semi-arid or semi-aerated flood plain

Depositional Model

The complex interactions of the subenvironments within the Springhill coalfield cannot be discussed within the scope of this paper, however the framework of the writer's depositional model in terms of basin architecture can be summarized in Figure 1. The figure illustrates an inferred early transverse flow dominated model which can be described as fluvial deposition on and from a semi-mature alluvial plain with subordinate lacustrine or mega-flood basin and associated minor deltaic deposition. Bivalves probably mark the perimeter of this "lacustrine" environment (Calder, 1981).

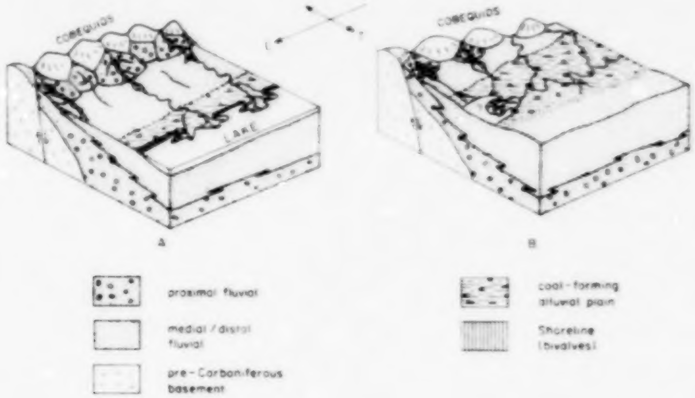

Figure 1. Possible basin fill patterns for the Westphaliar B Cumberland coal basin and Springhill coalfield after examples by Miall, 1981. Fig. 1a represents early transverse dominated fluvial basin with bivalue bearing shoreline facies. Fig. 1b represents later longitudinal dominated fluvial basin. (Not to scale.)

As the Cobequid Highlands shed more sediment and the basin filled, transverse flow gave way to longitudinal flow with one or more major meandering fluvial systems characterized by rapid lateral accretion through avulsion on a mature alluvial plain bordering a mature fan system. Rogue transverse ephemeral streams occasionally invaded the coal-forming forest moor where it bordered the alluvial fans.

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PEATLAND INVENTORY PROGRAM

A. R. Anderson and W. Broughm

INTRODUCTION

Peat is an accepted alternate fuel for energy production in many countries around the world. For several decades, peat fuels have been utilized at all scales of energy production.

Nova Scotia has about 160 000 ha of peatland (about 4% of the Province) concentrated in five or six regions of the Province (Fig. 1). As part of the ongoing inventory program, Guysborough County and Cumberland County were assessed to determine the extent of their peat resource.

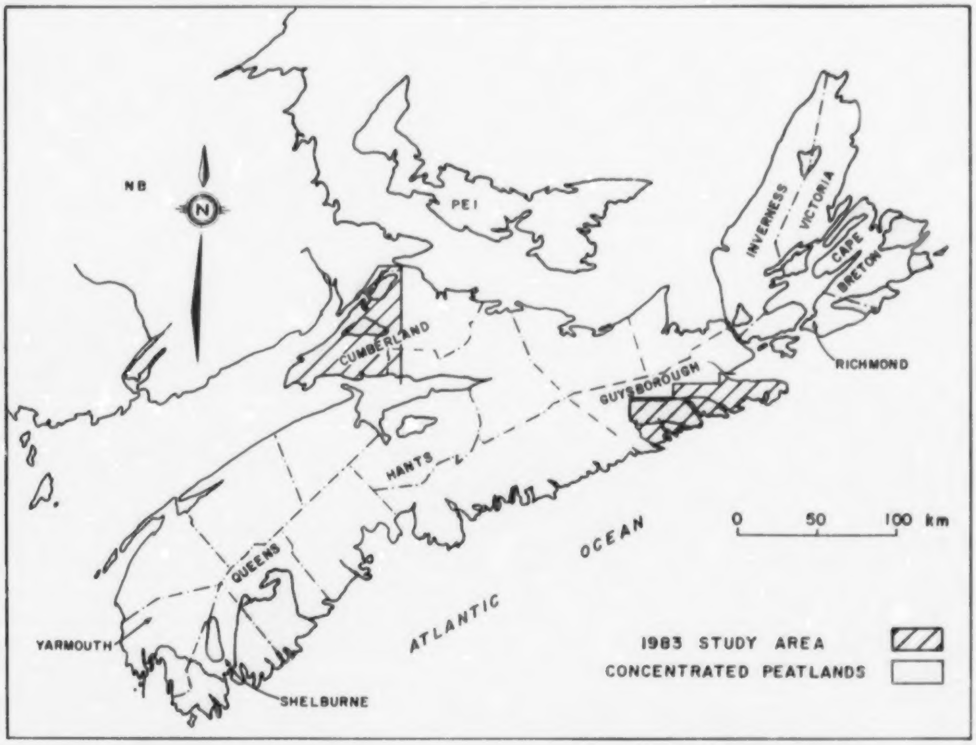

Figure 1. Peatland concentration regions of Nova Scotia.

PREVIOUS WORK BY THE PROGRAM

Southwestern Nova Scotia

This region was first investigated in 1980. By November of 1983, 16 700 ha of peatland had been evaluated, revealing an assessed volume of 370 million m^3 of in situ peat. Relative tonnages (@ 50% M.C.) indicate that 62 per cent of the peat evaluated in this region is classified as suitable "fuel grade" peat (Table 1).

Region	Year	Area Covered (ha)	Average Depth (m)	In situ Volume (x 10^6 m^3)			Tonnage (x 10^6) at 50% Moisture Content*			Per Cent Fuel Peat	
				H_{1-4}	H_{5-10}	Total	H_{1-4}	H_{5-10}	Total	Volume	Tonnage
Southwestern Nova Scotia	**1980	3 614	1.92	29.2	44.8	74.0	4.3	8.5	12.8	61	67
	***1981	6 505	1.79	56.8	78.4	135.2	8.3	14.9	23.2	58	64
	1982	6 606	2.59	79.1	85.9	165.0	11.6	16.3	27.9	52	58
	Average		2.10							56	62
	Resource Investigated	16 725		165.1	209.1	374.2	24.2	39.7	63.9		
	Resource Estimated	38 000		352	446	798	53	90	143	56	63
Hants County	1982	2237	3.24	51.0	29.0	80.0	7.5	5.5	13.0	36	43
	Resource Estimated	5851		112.3	77.2	189.5	16.4	14.7	31.1	41	47
Halifax County	***1981	225	3.06	6.1	0.7	6.8	0.9	0.1	1.0	10	13
	1982	38	3.09	0.8	0.4	1.2	0.1	0.08	0.18	33	44
Kings County	1982	504	2.19	5.49	5.54	11.03	0.8	1.05	1.85	50	57
	Resource Estimated	4451		48.5	49.0	97.5	7.08	9.30	16.4	50	57
Guysborough County	1983	3900	2.5	78	20	98	11	4	15	20	27
	Resource Estimated	14 400		-	-	360	-	-	54		
Cumberland County	1983	3500	2.5	65	22	87	9.5	4.2	13.7	25	30
	Resource Estimated	6700				167					

*Tonnes at 50% moisture content have been calculated using the following conversion factors

**Anderson and Broughm (1981)	H_{1-4} peat 0.146 t per in situ m^3
***Anderson and Broughm (1982)	H_{5-10} peat 0.190 t per in situ m^3

These values have been abridged from: Montreal Engineering Co. Ltd. (1980)

The fieldwork for this region has been completed, and efforts are being directed towards final mapping and development of utilization programs.

Halifax County

In addition to deposits in the central portion of the County studied in 1981, some deposits along the Eastern Shore (Port Dufferin-Quoddy) were assessed in 1982. The deposits were small and quite deep, having about 1 to 1.5 million m^3 of peat in total, of which 44 per cent is fuel grade peat.

Hants County

The 1982 inventory covered some 2200 ha of peatland in twelve deposits revealing about 80 million m^3 of peat, 36 per cent of which is classed as fuel grade peat. Data from the region indicate a potential for horticultural peat moss development.

Kings County

Peat deposits in the Aylesford-Berwick area were assessed during early 1982. Four deposits including the Caribou Bay (currently under peat moss production) were sampled. The short evaluation program covered 500 ha of peatland resulting in data for 11 million m^3 of peat of which about 50 per cent is fuel peat.

AREAS INVESTIGATED 1983

Cumberland County

The deposits evaluated in this region (Fig. 2), represent approximately 87 million m^3 of peat of which about 25 per cent is classed as fuel grade (H_{5-10}). The bogs are on average 2.5 m in depth, though sometimes reach as deep as 8 m. Data from these peatlands show large amounts of good quality moss peat that could be developed for horticultural use.

The entire county is estimated to have approximately 167 million m^3 peat in some 6700 ha of peatland of which some 75 per cent would be classed as suitable horticultural grade (H_{1-4}).

Guysborough County

County soil surveys (Nova Scotia Soil Survey Reports 1945-1973) indicate 14 400 ha of peatland (excluding salt marshes) in the county. Estimates of total resource show nearly 360 million m^3 of peat (54×10^6t), the majority of which is relative isolated in small deposits throughout the region. This resource is mainly found south of the Chedabucto Fault ranging from Canso across the Halifax-Guysborough county line.

Specific peat deposits have been evaluated for their peat moss potential in several reports on the Guysborough County resource, the latest of which, "Sutherland and Shea 1976", uses water holding capacity, ash

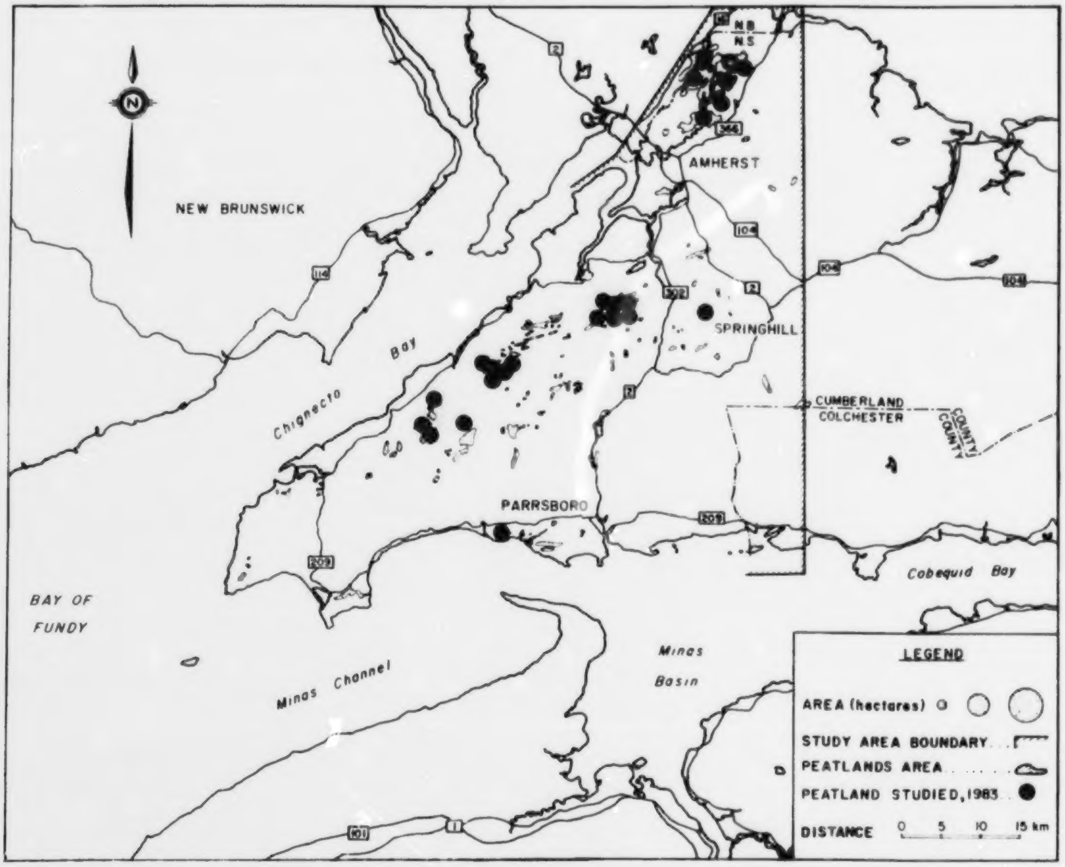

Figure 2. Peat deposits sampled in Cumberland County, 1983.

content and pH to provide data on peat quality. Data from this report and others will be later correlated with information obtained during this field season.

The relatively small peat deposits in Guysborough County are usually ombrogenic in nature, having well pronounced, poorly humified or "moss" peat domes. About 150 deposits were sampled through the course of the program (Fig. 3) revealing approximately 98 million m^3 of peat of which 20 per cent can be classified as "fuel grade" peat (H_{5-10}). The bogs (peat deposits) surveyed were on average 2-3 m deep, with specific sites reaching as deep as 9 m.

In terms of resource sampled deposits reveal about 11 million t of peat moss and about 4 million t of fuel grade peat. However, due to the relative isolation of the majority of deposits sampled, only a few could be considered commercially viable. There have been earlier attempts of peat moss extraction by dredge and press methods, but at present all have been abandoned due to high operational costs.

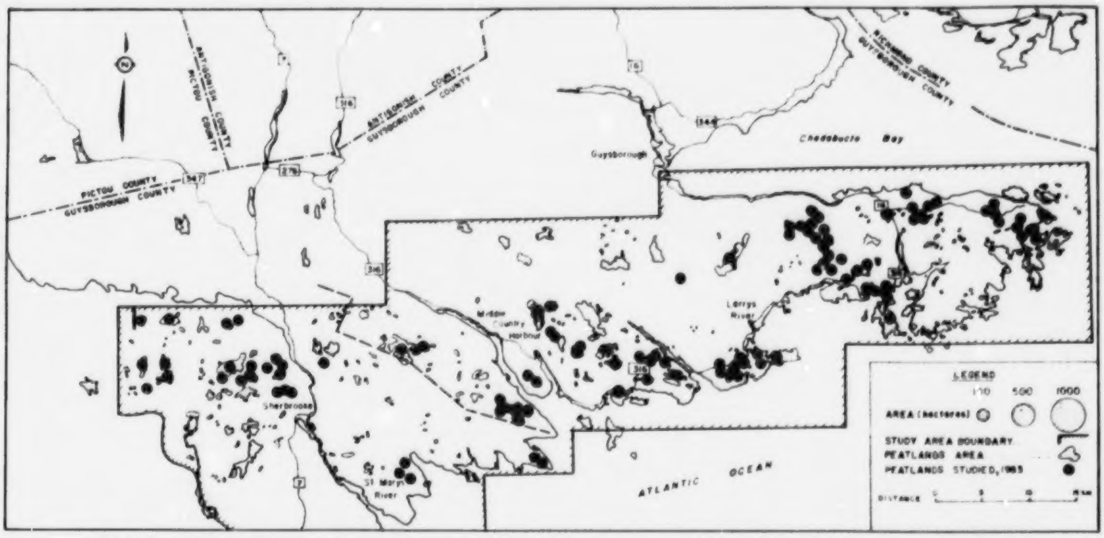

Figure 3. Peat deposits sampled in Guysborough County, 1983.

OTHER STUDIES

Remote Sensing

A joint project sponsored by the Nova Scotia Department of Mines and Energy and the Nova Scotia Land Survey Institute is currently underway to assess the potential of using LANDSAT imagery and a Computerized Image Analysis system for mapping peatlands in southwestern Nova Scotia.

Methodology developed in this project will hopefully allow computerized mapping of peat deposits across the Province. Eventually these techniques may be utilized in other mapping programs across Canada. The final product will be a series of 1:250,000 peatland maps producing regional summaries of the extent and types of peatlands across the Province.

SUMMARY

To date the Inventory Program has covered a total of 27,000 ha of peatlands on mainland Nova Scotia. The volumes associated with this total area are: 65 million m^3 horticultural grade peat (H_{1-4}) and 22 million m^3 fuel grade peat (H_{5-10}). These volumes equate to 9.5 million t of moss peat at 50 per cent moisture content and 4.2 million t of fuel peat under the same conditions.

Extrapolation of this data provides estimates of resource in the studied regions of 18 million t moss peat and 8 million t fuel peat (@ 50% M.C.) to date.

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1945 - Soils of Cumberland County.
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1980: Feasibility study for a peat fired steam electric power plant with specific reference to N.E. New Brunswick Canmet/EMR 8-9039.

ACADIA UNIVERSITY
DEPARTMENT OF GEOLOGY RESEARCH

Acadia University is located at Wolfville, Nova Scotia, in the eastern Annapolis Valley 100 km northwest of Halifax. The Geology Department consists of 7 full-time professors, 2 part-time lecturers, 2 departmental technicians, 1 secretary and 4 part-time research assistants. We have 139 undergraduate majors and 8 graduate students.

The Geology Department emphasizes an integrated field and laboratory approach and offers instruction and research training leading mainly to Bachelors of Science (3 years), Bachelors of Science with specialization (4 years), and Masters of Science (normally 2-years) degrees. There is an increasing trend towards undergraduates electing our 4-year programs. Six of our graduates students are full-time, and five of our Honours students are in their final year and working on theses. Research funding mainly comes from faculty grants and contracts which are now held by most of our staff. Most of our full-time graduate students also held fellowships.

Research conducted by the faculty and students is diversified. However, our main thrust is in Nova Scotian geology with various projects involving economic geology, igneous petrology, metamorphic petrology, geochemistry, biostratigraphy, sedimentology, ichnology, structural geology, and remote sensing.

The Department has geochemistry, sedimentology, X-ray diffraction, spectrography, paleontology, mineralogy, petrology, structural geology, ore microscopy, photogeology-cartography and photomicrography teaching and/or research laboratories. Our research facilities include, for example, two atomic absorption spectrophotometers, X-ray diffraction and fluorescence equipment, research microscopes, computer facilities, a photographic darkroom, nearly 100,000 feet of drill core from Nova Scotia, and a thin section preparation centre. Scanning and transmission electron microscopes, mass spectrometer, and gas chromatography are available for cooperative use in other science departments, and we make regular use of the University's CYBER 171 computer. The Science Library at Acadia is in the same building as the Geology Department and the Geology Department is a Federal Map Repository.

FACULTY RESEARCH

The major research projects of the faculty now are as follows:

Professor S. M. Barr - Continuing a detailed study based on mapping of granitoid intrusions in Cape Breton Island and southwestern mainland Nova Scotia. Petrological investigations document the range of rock types present, their ages, and their geochemical characteristics, and hence their potential for economic mineralization. An increased emphasis on associated mineral occurrences will include ore petrology and fluid inclusion studies.

Professor B. W. Cameron - Origin of chert in the Jurassic Scots Bay Formation, Nova Scotia; Microbial trace fossils as paleoenvironmental indicators; Barrier island development; Modern quartzose stromatolites.

Professor J. A. Colwell - Clay mineralogy and diagenesis related to petroleum potential, Sydney Basin pilot study; Tungsten mineral deposits; Geology of the North Mountain Basalts.

Professor R. G. Moore - Biostratigraphy of the Windsor Group in the Parrsboro-Upper Economy areas and Cumberland and Colchester Counties, Nova Scotia.

Professor R. G. Stevens - Interpretation of remote sensing imagery for megastructural and economic geological applications; computer graphics in structural analysis; Primary structures of igneous rocks; Mesostructure and microfabric of deformed rocks; Participating with J. Colwell in clay mineral diagenesis project (see above); Geological parameters for radio-active waste depositories.

Professor R. P. Raeside - Stratigraphy, deformation and metamorphism of presumed George River Group sedimentary rocks, and Central Highland gneiss, Cape Breton Highlands; Metamorphism of Meguma Group, Shelburne-Pubnico.

Professor N. A. Van Wagoner - Determination of the pre-Carboniferous tectonic evolution and metallogenesis of the northern Appalachians based on detailed studies of the physical volcanology, stratigraphy and sedimentation of volcanic and volcaniclastic rocks of Cape Breton Island and southern New Brunswick.

DALHOUSIE UNIVERSITY GEOLOGY DEPARTMENT: RESEARCH WORKERS AND THEIR INTERESTS

R. Boyd: Coastal and continental shelf sedimentation. Current projects include evolution and sediment dispersal in the coastal zone of Nova Scotia and sedimentation patterns in abandoned Mississippi deltas.

D. B. Clarke: Granites, kimberlites, volcanics of the continental shelf. Mineralogy, petrology, geochemistry, isotope geochemistry of Appalachian granites. Phase equilibrium studies of potassic sulphides.

M. R. Gibling: Fluvial sedimentology, Carboniferous of Nova Scotia, coal and oil shale in Carboniferous of Nova Scotia, stratigraphy and hydrocarbon potential of offshore Atlantic, Arctic glacial and post-glacial sediments.

J. M. Hall: Nature of the oceanic crust through deep drilling, tectonic and magnetic studies.

R. A. Jamieson: Ophiolites, Appalachian geology (particularly Cape Breton Island); igneous and metamorphic petrology.

F. S. Medioli: Micropaleontology, shallow water foraminifera; thecamoebians, ostracods, nannofossils.

G. C. Milligan: Structural geology of Cape Breton Island.

G. K. Muecke: Metamorphic petrology, geochemistry; distribution of rare earth elements.

P. H. Reynolds: (Jointly with Physics) Ar^{39}/Ar^{40} dating; isotopes of oxygen and sulphur.

P. T. Robinson: Lithological, geochemical and structural state of the oceanic crust.

P. J. C. Ryall: Magnetic studies of oceanic crust at mid-ocean ridges; development of underwater electric reconnaissance vehicles for sea floor study.

P. E. Schenk: Appalachian geology; transatlantic Paleozoic reconstructions; Carboniferous carbonates, sulphates, redbeds.

D. B. Scott: Micropaleontology; marsh and estuarine foraminifera; fresh water Thecamoebians; Holocene sea level changes, deep-sea agglutinated foraminifera.

M. Zentilli: Metallogenic and tectonic evolution of the central Andes and of Nova Scotia; volcanology; isotope geology. Uranium distribution in different environments. Volcanic rocks as a source of uranium in ore deposits. Fission track dating.

C. Beaumon (Oceanography Department): Vertical movements of the earth and the rheology of the interior of the earth, development of sedimentary basins, ocean and earth tides.

REMOTE SENSING GEOLOGICAL INVESTIGATIONS
A SUMMARY REPORT

M. S. Akhavi* and E. Wedler*

BACKGROUND

Nova Scotia Land Survey Institute was founded in 1949. It operates as a technical training facility under the direction of the Adult Education Division, Department of Education, Province of Nova Scotia. The remote sensing program was established in 1977 to provide comprehensive training to multidisciplinary technologists and professionals, and to meet industry and government needs for personnel in this field. The program is designed to accommodate individuals who have training or experience in fields in which new technical developments have taken place and in which retraining is necessary. The 50 week program provides the student with a knowledge of aerial photography, data acquisition platforms, and remote sensing systems. Supplementary study in the fields of drafting and computer programming is designed to develop the student's ability to operate independently or within large organizations. A cooperative project with an outside agency provides an opportunity to integrate skills learned in various earth resources disciplines, or subjects.

Each student is required to undertake a cooperative project in their area of expertise and with an outside agency. The basis of each project includes an in-depth analysis of all forms of available remote sensing imagery to assist in solving resource management and environmental monitoring problems. The cooperative project is an integral part of the training program. Efforts are made to match requirements of industry with the ability and career interests of students, keeping in mind the overall instructional and educational intent of the cooperative project. A majority of projects conducted in the 1982-83 session were assisted through efforts of the Technology Enhancement Office of the Canada Centre for Remote Sensing.

SUMMARY OF REMOTE SENSING INVESTIGATIONS

The following are brief summary highlights of six different cooperative projects sponsored by the Nova Scotia Department of Mines and Energy and conducted by our last year's graduates:

1. Structural analysis of the Sydney Basin (Everett, 1983). In this study conventional black and white, and colour infrared (CIR) aerial photography, as well as multispectral scanner (MSS) data were used to map structural and geologic features. As a result, an interpretive geologic map (1:50,000 in scale) was prepared delineating linear and glacial trends. A major synclinal structure was mapped south of the Sydney Airport utilizing digitally enhanced 11 channel MSS data.

2. Geological Study of the Cobequid Highlands (Melvin, 1983). A geological appraisal of the Cobequid Highlands was made based on vegetative and lineament enhancement of digital Landsat imagery.

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*Nova Scotia Land Survey Institute, Lawrencetown, Annapolis County, Nova Scotia.

Digital airborne MSS and MEIS II (Multi-Detector Electro-Optical Imaging Scanner) data, as well as CIR photography were used in test site localities. A lineament map (scale 1:15, 840) was produced to indicate the possibility of existence of a major shear zone covering approximately 16 km^2 in this region. Many intersecting linears were also detected and mapped.

3. Peatland mapping in southwest Nova Scotia (Neilly, 1983). The aim of this research was to find a workable method for delineation of peatlands using computer classificaiton of temporal Landsat imagery. Satisfactory results were obtained when bog surfaces were classified versus mineral soil. The results proved transferable from one study site to another in this region, but were inadequate from inland to coastal peat zone areas.

4. Study of granitic rock bodies at Guysborough County, Nova Scotia (Robinson, 1983). This project is still under investigation. The possibility of mapping the areal extent and boundaries of various plutonic rock bodies using digitally enhance Landsat data has been demonstrated. Moreover, it is postulated that small circular features may occur within large granitic bodies in this area.

5. Geologic mapping, Eastern Shore, Nova Scotia (Statts, 1983). Conventional and digital remotely sensed data (both airborne and spaceborne) were utilized in this investigation. The result is an interpretive geologic map of the area (scale 1:50,000) which includes numerous, previously unmapped lineaments within the Meguma Group rock types. Lithologic discrimination is limited to delineation of granitic rocks in areas where the bedrock is not heavily masked by glacial overburden.

6. Terrain analysis of glacial features at the Cobequid Highlands, Nova Scotia (Wyllie, 1983). This study contains background information such as soil cover, aggregate mapping, and forest inventory of the area. The possibility of differentiating glacio-fluvial deposits and till terrains has been inferred.

FUTURE COOPERATIVE PROJECTS

Cooperative projects conducted during the 1982-83 session averaged about 800 hours, at no labour charge to the cooperative project sponsors. Use of the ARIES II digital image anlysis facility was complemented in several projects by work on a Geographic Information System held on the PRIME 550 computer at NSLSI.

Projects in the 1983-84 session are presently underway; the results of which are to be presented at a one-day seminar in mid-August 1984. Vice-Principal, J. F. Wrighman, oversees the administration of the overall remote sensing program, while instructors, M. S. Akhavi and E. Wedler, manage and direct the cooperative projects on a daily basis, interacting with contacts from cooperative sponsors are required.

In a continuing effort to secure high quality cooperative projects in the future, invitations and inquiries are being accepted and reviewed with both government and industry.

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ST. FRANCIS XAVIER UNIVERSITY
GEOLOGY DEPARTMENT FACULTY

R. F. Cormier, Ph.D. (M.I.T.), teaches courses at St. Francis Xavier in petrology and geochemistry of rocks. His major research activity is determining the age of rocks based on ratio of radioactive rubidium to strontium.

K. Greenidge, Ph.D. (Harvard), teaches an introductory course in oceanography, geomorphology, and pleistocene geology. His research interests combines oceanography, botany, and pleistocene geology. Much of his research effort has focused on northern Cape Breton and Aspy Bay.

J. Brendan Murphy, Ph.D. (McGill), joined our full-time teaching staff in September 1983. His area of special expertise is structural geology, and igneous and metamorphic petrology. His present research includes tectonics and magnatism of the Antigonish Highlands.

Cindy Murphy, M.Sc. (McGill), is an instructor with principal responsibility for laboratories in introductory geology and in some advanced courses. She is working on the Devono-Carboniferous igneous rocks in the Gaspe Peninsula.

William S. Shaw, Ph.D. (M.I.T.), is the Chairman of the Department and teaches oil and gas geology, coal geology, stratigraphy, and geophysics. He came to St. Francis Xavier after a long career in oil exploration. Oil, coal, salt, and ore deposits are his chief research interest.

H. C. Teng, Ph.D. (U.N.B.), teaches the fundamental properties and recognition of minerals, in addition to structural geology and ore deposits. A strong background in applied mining geology, together with a research interest in ore deposits associated with magmatism and tectonics, makes his teaching particularly effective in these fields.

NOTES ON DEPARTMENTAL RESEARCH ACTIVITIES, DEPARTMENT OF GEOLOGY, SAINT MARY'S UNIVERSITY

LATE CENOZOIC OSTRACODS FROM DRILLSITES IN THE MACKENZIE DELTA AND BEUFORD SEA

A rich late Cenozoic ostracod fauna has been found in drill sites in the MacKenzie Delta and Beaufort Sea. We are examining and identifing the ostracod species found in these wells and relating them to their systematic positions, their probable environments in life, and the horizons in which they are found.

The research on the living marine ostracods of Atlantic Canada is also progressing well. (Q. A. Siddiqui)

AVALONIAN VOLCANIC ROCKS OF NOVA SCOTIA

The geochemistry of Precambrian and Paleozoic volcanic rocks from several type-areas is the subject of an on-going project. This study aims to characterize the rocks, to recognize the most plausible tectonic environments responsible for their formation, and to put constraints on the origin of the volcanics. (J. Dostal)

NORTH MOUNTAIN FORMAITON BASALTS, NOVA SCOTIA

As part of a study on petrogenesis of continental tholeiites, the geochemistry of Early Mesozoic North Mountain Formation basalts has been investigated. Compared to oceanic tholeiites, the North Mountain basalts have similar abundances of major, rare-earth and some high-field strength elements but are higher in K and associated elements and Th. They were probably derived by partial melting from an upper mantle similar to that for oceanic tholeiites, but were affected by crustal contamination. (J. Dostal)

U AND TH IN PALEOZOIC VOLCANIC ROCKS FROM NOVA SCOTIA

The study shows that Cambrian rhyolites are strongly depleted in the radioactive elements compared to younger volcanics. This depletion is related to secondary processes. In basalts, U and Th are not affected by greenschist facies metamorphism. In rhyolites, these elements are closely related to K whereas in basaltic lavas, the two elements correlate with immobile incompatible elements such as Zr, Nb, La, and Ce. (J. Dostal)

STRATIGRAPHY AND SEDIMENTOLOGY OF GOLDENVILLE FORMATION, EASTERN SHORE, NOVA SCOTIA

The Cambro-Ordovician Goldenville Formation, which underlies much of southern Nova Scotia, consists of repetitively interbedded slates and metamorphosed sandstones. A new technique, involving the use of a portable vertical gradient magnetometer, has been used to identify marker horizons and subdivide part of the Formation into stratigraphic units in the area west of Sheet Harbour. Individual beds and pockets of beds have been traced up to 15 km along strike, forming the basis for an intensive study of their sedimentology. This work is carried out under Federal Department of Supply and Services contract in co-operation with the Geological Survey of Canada and the Nova Scotia Department of Mines and Energy, as part of the Canada-Nova Scotia Co-operative Mineral Program. (J. W. F. Waldron and L. R. Jensen)

THRUSTING AND MELANGE DEVELOPMENT IN NEWFOUNDLAND APPALACHIANS

Melanges are believed to form by a variety of processes ranging from gravitational down-slope movements at the Earth's surface to deep-seated tectonic deformation at convergent plate boundaries. Melanges are widespread in the Newfoundland Appalachians where they occur in association with ophiolites representing fragments of ancient oceanic crust. Field studies of two contrasting melanges, at the Bay of Islands on the west coast and at Carmanville on the east coast, have concentrated on separating later structural events from the initial melange-forming process; this is believed to have been predominantly shallow tectonic deformation in the Bay of Islands but predominantly sedimentary at Carmanville. This work is supported by an NSERC operating grant. (J. W. F. Waldron)

GEOLOGY OF THE PARRSBORO REGION, COBEQUID HIGHLANDS

Detailed mapping and subsequent petrographic and geochemical analysis of samples is being carried out in the Parrsboro area to define more precisely the primary setting of Hadrynian and paleozoic igneous rocks and the structural and metamorphic history of the area. Local volcanic stratigraphies have been established in the Hadrynian Jeffers Brook Formation. Detailed mapping in the type section has confirmed the recumbent folding hypothesis of Donohoe. The metamorphic facies of the Jeffers Brook Formation is actinolite-chlorite. Biotite is commonly developed during thermal metamorphism around plutons. The rare mineral carpholite has been identified in mylonite zones in carboniferous quartzites associated with the Cobequid fault; previously, this mineral was believed to be indicative of subduction zone metamorphism. This work is supported by NSERC. (G. Pe-Piper)

CRETACEOUS VOLCANISM, OFFSHORE EASTERN CANADA

Early Cretaceous volcanic rocks are known from several wells on the Scotian Shelf and Grand Banks. Volcanics of uncertain age occur in the Montagnais and Northumberland Strait wells. The petrography, geochemistry, and radiometric ages of these rocks are being investigated. Most of the rocks are alkali basalts associated with reactivation of deep-seated fractures. The analysis of stable isotopes is presently underway to investigate the roles of mantle heterogeneity and crustal contamination in the evolution of both the Cretaceous and the Triassic rocks of the area. This work is supported by an EMR Research Agreement. (G. Pe-Piper and L. F. Jansa)

UPPER CARBONIFEROUS STRATA OF THE EAST HALF OF THE TATAMAGOUCHE SYNCLINE, CUMBERLAND BASIN, NORTHERN NOVA SCOTIA

This research includes the mapping of the Upper Carboniferous strata and the investigation of the sedimentological features; the determination of stratigraphy, structure and diagenesis of the strata;

and the interpretation of current directions, source areas of the detritus, and environments of depositon. Research also includes an evaluation of mineralization (Cu, Pb, Ag, U) processes and mineral potential. Special emphasis is placed on calcrete development in semihumid environments and physical diagenetic sedimentary structures. This research is funded by the Geological survey of Canada and the Nova Scotia Department of Mines and Energy through a Federal Department of Supply and Services contract. (R. J. Ryan)

PALEONTOLOGY IN THE WINDSOR GROUP OF ATLANTIC CANADA

The research focuses on utilizing Ectoprocta (bryozoans) as possible guide fossils within the Windsor Gtoup. The investigation of the paleontology and paleocology of the Gay's River Formation is a continuing part of the research work. (R. J. Ryan)

EXPLORATION METHODS PROJECT WORK
MINERAL TECHNOLOGY
UNIVERSITY COLLEGE OF CAPE BRETON

M. R. Oldale*

During the second year of the 2 year Mineral Technology Progam at University College of Cape Breton, one day a week during the autumn months is devoted to a group field project. This project is an integral part of the Exploration Methods and Geology courses completed during the senior year. The courses include the fundamentals of field geology methods, structrual geology, and economic geology.

A geological environment with litholigical and/or structural contrast is selected. Grid lines are then flagged and taped using existing roads as baselines or tielines. Magnetometer, electromagnetic (VLF-EM), soil and stream sediment sampling, and outcrop mapping are conducted over the grid area.

During the winter months, the data is compiled on maps, profiles, and sections as a part of the laboratory work. Thin and polished sections may also be made from selected field samples. Geochemical elemental analyses utilizing colormetric and atomic absorption methods are completed on soil and stream sediment samples as part of the assaying course. Reports typically show a geological cross section along with topographical, geochemical, and geophysical profiles. Geophysical plans are contoured.

In addition to the above, students are required to complete a technical report, based on some aspect of the group project, or upon an appropriate individual field project.

Exploration companies operating in the area may find some of this information useful. The data is filed in the Mining Science Laboratory and may be viewed on an open file basis by contacting the College faculty members in Mineral Technology at the College. Some of the more recent projects are shown in Table 1.

Project No.	Project Name	Geological Environment	Size of Area	Geology Mapping	Line Interval	Station Spacing	VLF-EM	Fluxgate Magnetometer	Proton Magnetometer	Geochemical Elements	Map Scales	Section Scales
81-1	Watson Brook	Cambrian/ Precambrian volcanic and Mississippian Sediments	1.6 km^2	Grid Lines and Brook	200 m	40 m	X	X		Co-Pb-Zn-Ag	1:4000	1:4000
82-1	Mineral Rock	Fourchu Extrusives Cambrian Sediments	3.2 km^2	Road and Brook	200 m	40 m	X	X	X	Cu-Pb-Zn-Ag	1:4000	1:4000
83-1	Mineral Rock	Unconformity Penn. - Cambrian	2.6 km^2	Grid Lines Brook	200 m	40 m	X		X	Cu-Pb-Zn-Ni	1:4000	1:4000
83-2	Ocean view	Metamorphosed Mid-Cambrian Sediments	1 km^2 4 km^2	outcrop locations	100 m	20 m	X	X	X	Cu-Pb-Zn-Co-Mn-Ag-Bi	1:2000 1:5000	-
84-1	Blue Mountain	Metamorphosed Mid-Cambrian Sediments	2.1 km^2	Grid Lines Plain Table	200 m	40 m	X		X		1:4000	1:4000

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RESEARCH INTERESTS
DEPARTMENT OF GEOLOGY; UNIVERSITY COLLEGE OF CAPE BRETON

E. L. Zodrow*

MAIN RESEARCH AREAS

1) Phytostratigraphy of the Upper Carboniferous system.

2) Trace-elemental stratigraphy of Cape Breton coals.

3) Statistical investigations.

DETAILS

1) The fossil plant record of the Sydney coalfield was re-evaluated. We concluded that the Morien Group is relatively younger than hypothesized by Bell in 1938. Specifically, the upper parts are Stephanian (Point Aconi strata from the Hub-Lloyd Cove seams interval upward), whereas the lower sequences appear to be Westphalian D. However, more data is required to confirm the details.

We studied the Mabou coalfield to correlate it with the Sydney coalfield. A preliminary conclusion is that Mabou is high Westphalian C (probably streaching into D).

2) Channel samples of the major coal seams, using 15 cm sampling intervals, are being analyzed for 44 chemical elements including U, Th, Au, Hg, Ag, W, Zn, Ni, Mn, V, and W. Preliminary results indicate chemical zonation of the coals, epigenetic mineralization, and a very complicate transitional lithology between the roofs and overlying shales.

A carbon isotopic study is under way, as well as sulfur isotope investigation.

3) Our work includes, predicting the thickness of offshore coal seams estimating tonnage by statistical means and giving confidence limits, estimating urianium and thorium, and population modelling for some trace elements.

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